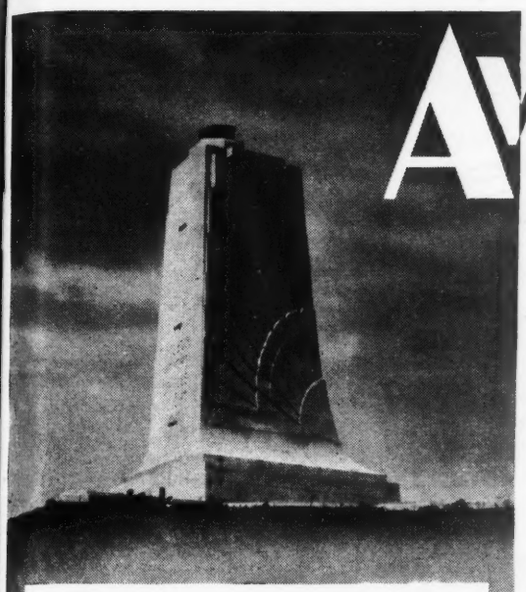

AVIATION

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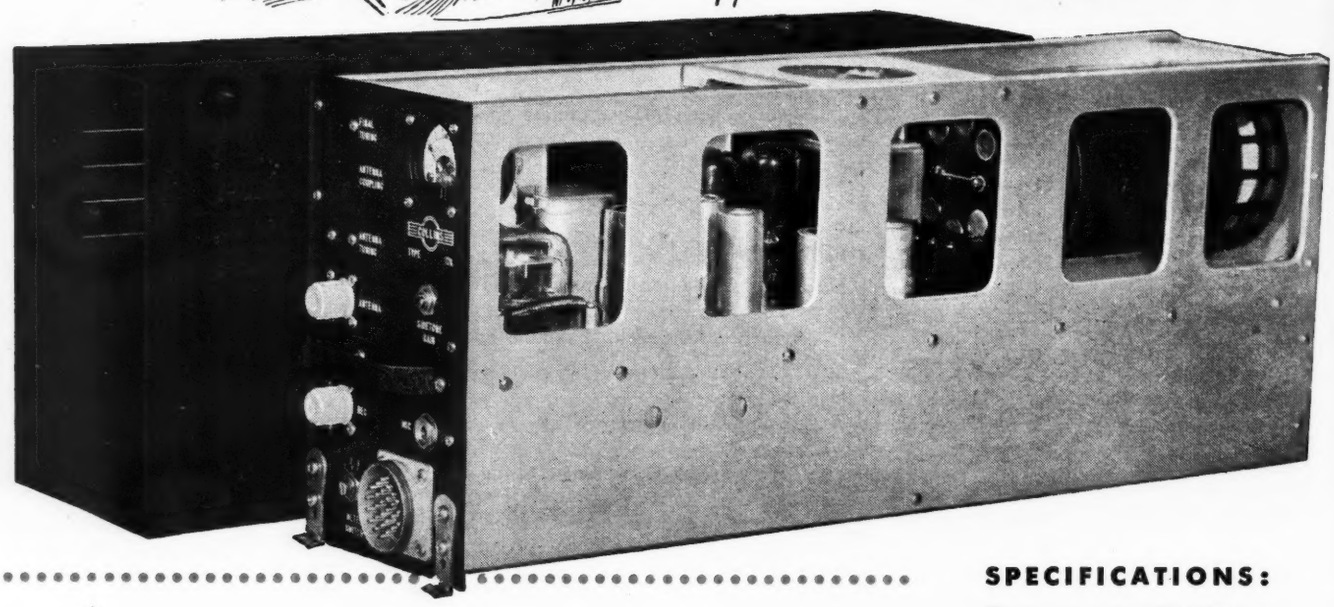
The Collins 17K-1 Transmitter



Lightweight VHF for Aircraft

The 17K-1 is a five frequency, crystal controlled radio transmitter for commercial and itinerant aircraft use in the 122-132 mc band. The complete transmitter, including a dynamotor power supply, is housed in a single ½ ATR unit cabinet. Transmitter, control box, and interconnecting cable weigh less than 20 pounds.

Remote control facilities allow complete freedom in locating the 17K-1 in the plane. An antenna transfer relay is available, if desired, in order to operate a receiver from the transmitting antenna.

The power output, adequate for the VHF range, is conservatively rated at 5 watts. Total power drain is held to a minimum during both stand-by and operation.

The audio circuit employs peak clipping to raise appreciably the effective modulation level and allow full use of the carrier power.

The 17K-1, thoroughly engineered and flight tested, enables its owners to obtain maximum benefit from the new VHF aircraft frequencies. Write today for early delivery. The Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

SPECIFICATIONS:

Frequency range: 122-132 mc.

Size: ½ ATR unit.

Total weight: less than 20 pounds.

Number of frequencies: five.

Frequency control: quartz crystals.

Power output: 5 watts minimum.

Type of emission: voice modulation.

Output impedance: 50 ohm concentric line.

Power source: 12 volts d-c or 26.5 volts d-c.

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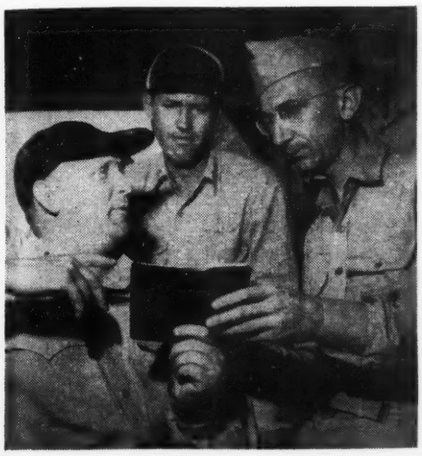

E. H. HEINEMANN (right), chief engineer of Douglas' El Segundo plant, shown with the late Capt. "Dixie" Keiffer (left), skipper of the famed "Fighting Lady," the U. S. S. Ticonderoga, and her Air Officer, Cmdr. Clair Miller, as the carrier hunted Japs in the Pacific. Heinemann was getting first-hand tactical information to apply to a new Navy plane—the Douglas BT2D, first details of which are given in his own words in the thoroughgoing engineering article starting on page 55. He not only analyzes the craft's unique fuselage dive brakes, but also gives all the background of its development, showing how the weight-bogey was whipped to give added payload—and give it in a hurry.

The discouragingly low aircraft production figures which have been reported in our news section are of vital concern to more than the aviation industry itself. They have a direct bearing on every man, woman, and child in the country, for they show only too clearly how our airpower is rapidly being drained away. This frighteningly low plane output stems right back to our lack of an air power policy, without which research and development can't progress. Prefaced by the Editor, who tells (page 37) just what we need to overcome this condition, E. E. Wilson points out (page 38) just why this country must have a sound air power policy regardless of what's done about Army-Navy mergers or reorganizations —he shows how we have to get the horse before the cart if we're going to maintain our requisite aviation position in this world.

Our Research - Engineering - Production section this month presents the first details of the Grumman GR-1 automatic pilot, giving not only its basic engineering principles, but also showing just how its fingertip control can make it maneuver the plane regardless of altitude. Raymond N. Greif gives all the dope in the article beginning on page 68.

For aircraft operators who have long been plagued by the lack of precise information on fuel detonation in actual flight, Robert J. Clark and Richard M. Adams of Pan American reveal (page 63) their successful system for gathering and interpolating data which means more payload and better performance.

Seven new planes are covered in this issue. Beginning on page 90 you'll find descriptions and data on the brand new Republic XP-84, and then there are six personal planes—the new low-wing single-place Luscombe; the Thorp Sky Skooter, designed by the engineer on Lockheed's Little Dipper (which we show in the first published sketch); the Ross Sportplane for low cost time-building; the Kaiser-Hammond four-five place pusher; the Hervey Travelplane, a new roadable project; and Britain's Miles Gemini twin-engine four-placer.

LATHROP B. NELSON, manager of Aeronca's Service & Parts Dept., who shows (page 44) just how that company has set up its spare parts program, detailing just what's done to make sure the customer gets what he needs when he needs it, and thus insure the distributor and dealer of the maximum possible profit. (Carlson photo)

Down the Years in AVIATION'S Log

25 Yr. Ago (1921) — Ralph Upson wins International Balloon Race, covering 425 mi. in 34 hr. 40 min. . . . New Chicago Post Office has 800-ft. landing strip on roof. . . . Army and Navy make Billy Mitchell-inspired bombing tests on obsolete, radio-controlled naval vessels. . . . Bert Hathaway of San Francisco is hailed as first U. S. college student to fly to classes. . . . Postmaster General rides airmail plane Washington-N. Y. but takes train back. . . . First airway guide is 24-page *L'Indicateur Aerien,* published in Paris. . . . First Reserve Pilot Training Camp is opened at Camp Atwood, N. J. . . . Civil Service Commission announces exams for licensed aircraft mechanics. . . . Post Office cancels private airmail contracts on N. Y.-Chicago route. . . . Oakland, Calif., air service starts commercial freight carrying business. . . . James Otis, San Francisco exporter, flies first business trip from Redwood City, Calif., to Caracas, Venezuela.

15 Yr. Ago (1931)—Post Office Dept. rules that airmail planes must not wait more than 30 min. for connections. . . . Detroit *News* uses first autogiro in newspaper field. . . . Total of 32 states now have aeronautical governing bodies. . . . Mexico City stages first Aero Show. . . . Navy conducts tests on cockpit noxious gases. . . . Junkers builds Ju-52 single engine freighter with 6,600-lb. capacity. . . . Total aircraft sales for past year surpassed $60,000,000.

10 Yr. Ago (1936) — Domestic Air Traffic shows 68% increase in past year. . . . TWA is only means of communication with flooded Pittsburgh, carrying medicine and nearly 1,000 passengers during period. . . . Braniff and C & S buy Lockheed Electras to expand their services. . . . Air Corps spends $5½ million for engines and asks bids for 250 twin-engine and 75 multi-engine bombers, also 175 fighters. . . . Germany prepares to start 7-day round-trip airship service from Hamburg to Lakehurst. . . . TWA, American, Eastern, United, and Pan American combine to guarantee $500,000 experimental costs to Douglas for 40-passenger airliner capable of travel at 20,000 ft. . . . House Military Affairs Committee proposes Governor's Island, N. Y. C., as municipal airport.

The New Culver Model "V"

The new Culver high-performance personal plane with Simpli-Fly Control and retractable tricycle. landing gear has adopted the accuracy and reliability of Scout flight instrumentation as a means of making it possible for owners to get the maximum utility from the plane. Standard are the new Scout Compass, Standard Altimeter and Air Speed Indicator. Special equipment includes Sensitive Altimeter and Rate of Climb Indicator.

Kollsman-built Scout Instruments now put Kollsman precision within reach of every plane owner, backing up his investment in plane and engine with new reliability in aids to flight and navigation. It is on such instruments that the owner must rely to realize the greatest usefulness and safety in his ship. So look for Kollsman instrumentation in the plane you plan to buy. Or, if you now own a plane, consider how much more you can get out of it with the reliability and accuracy of Kollsman-built instruments. Write today for complete information on these instruments to Kollsman Instrument Division, Square D Company, 80-08 45th Avenue, Elmhurst, N. Y.

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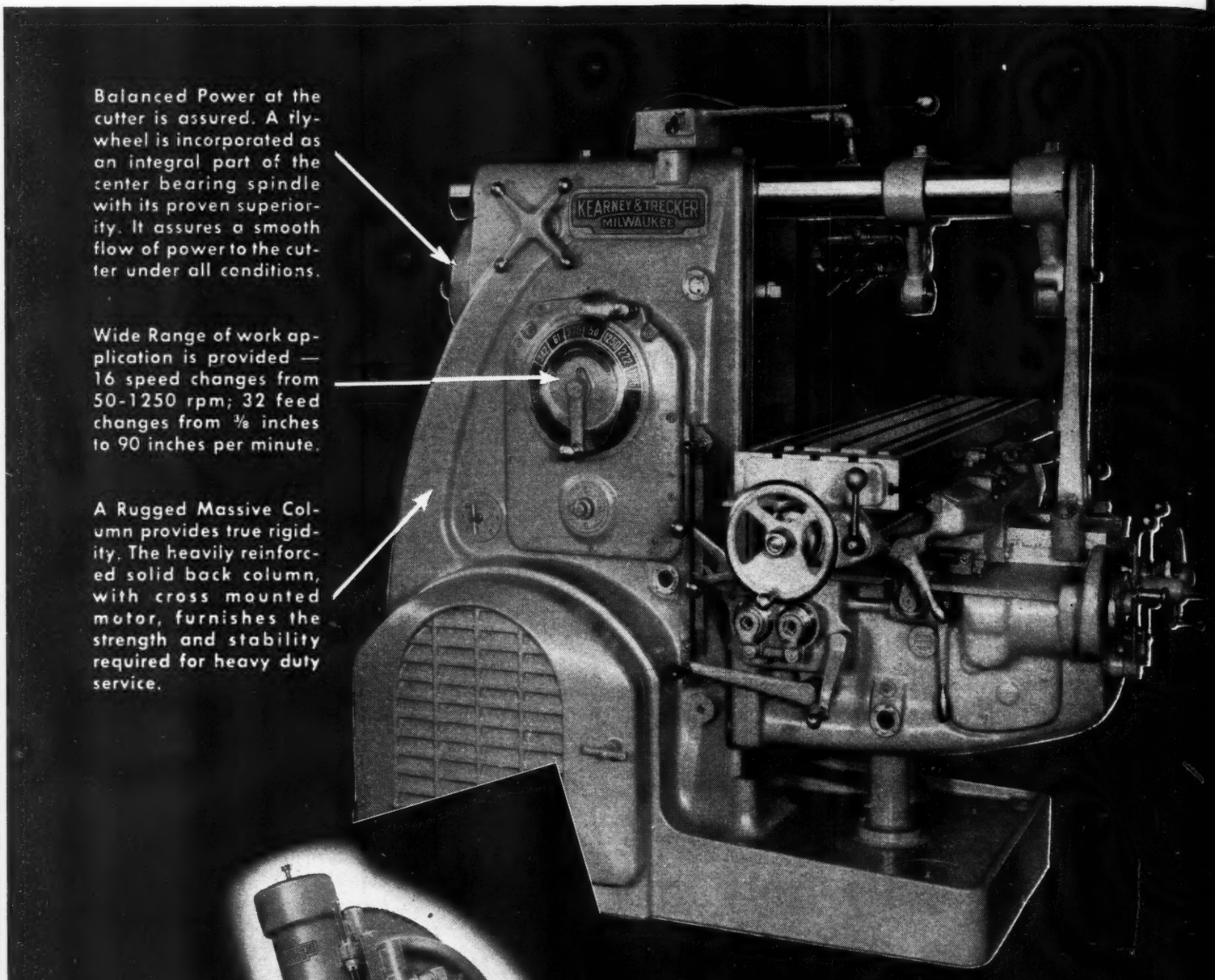

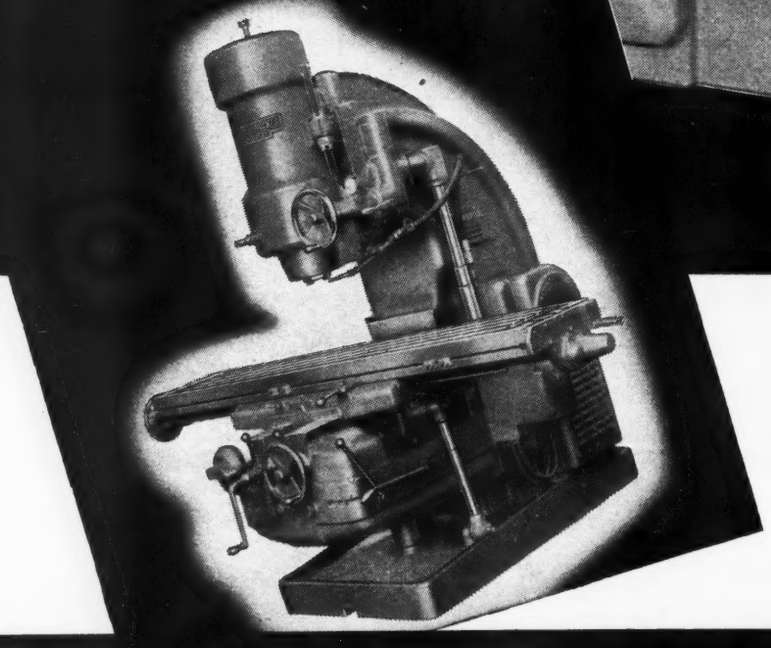

30 HP CSM HORIZONTAL knee-type machine illustrated a shows the modern, compact design, rugged construction and veniently accessible controls. Rugged and versatile — all mode the CSM series are designed to meet the stringent requirement the high rate of metal removal possible when using carbide cu

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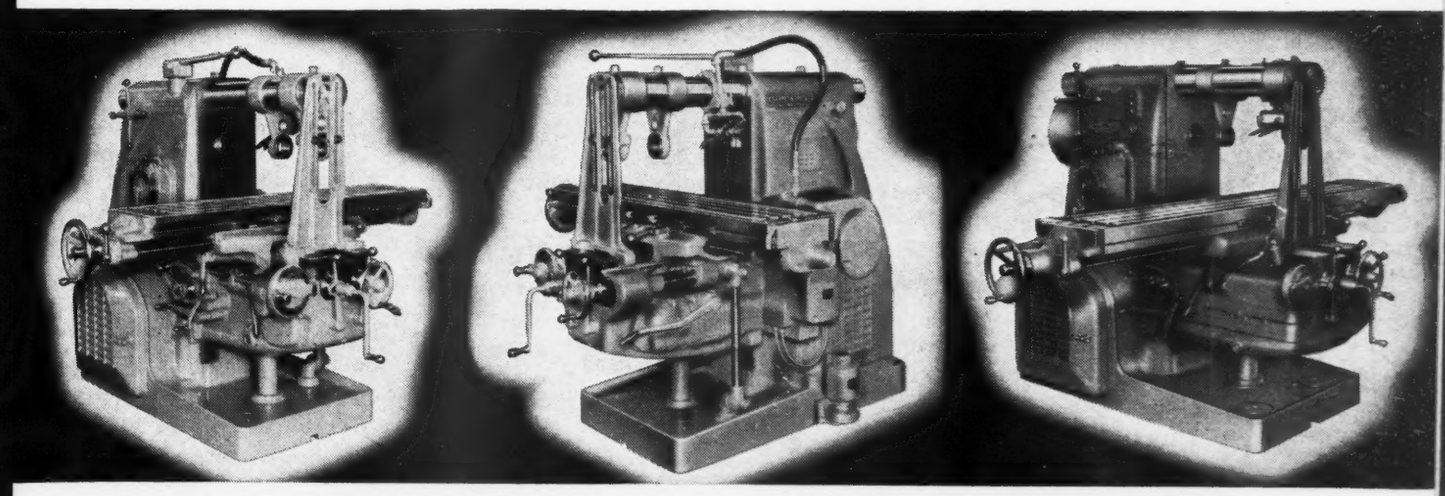

A complete series of power rated machines, in horizontal and vertical models, to meet your requirements.

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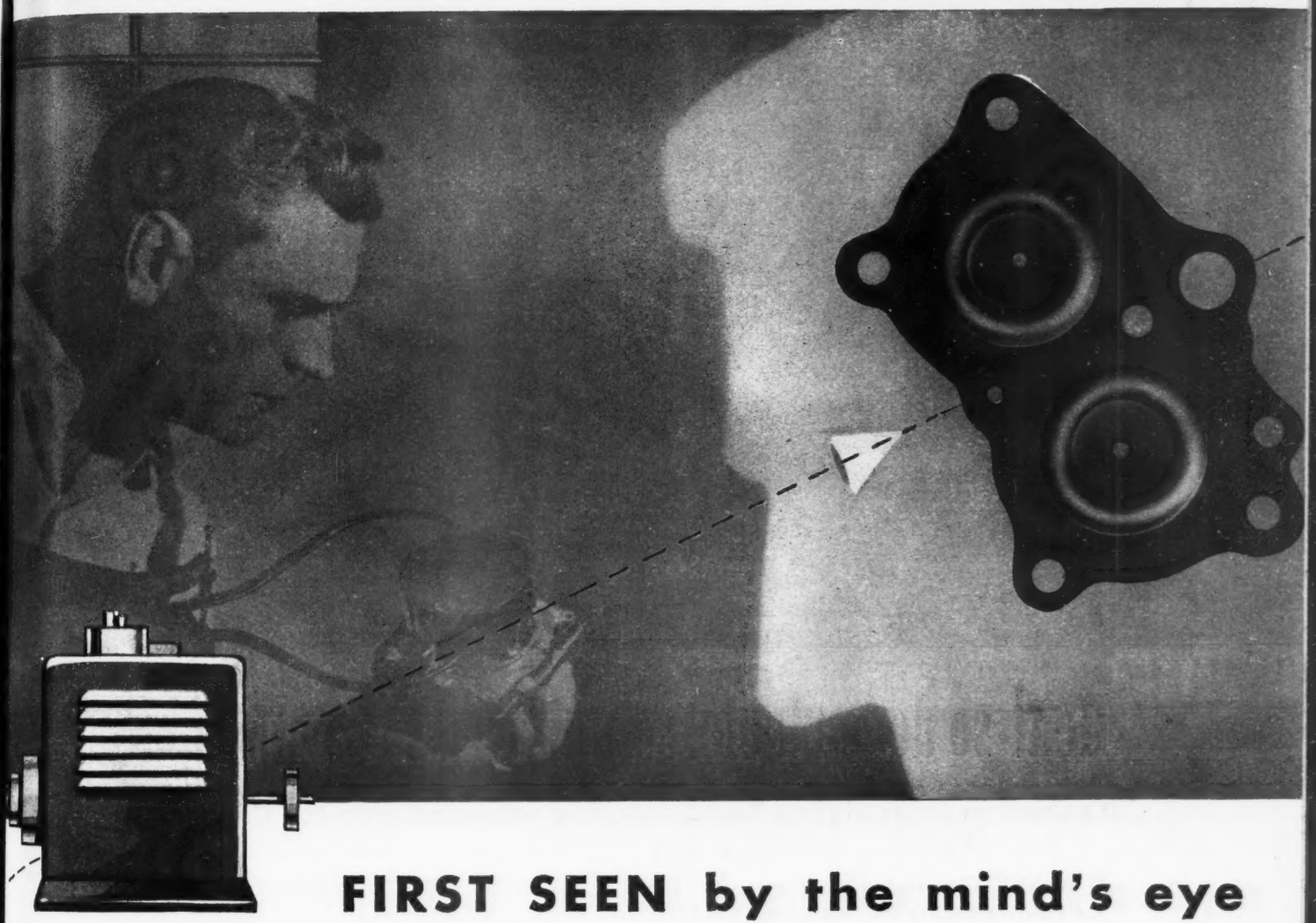

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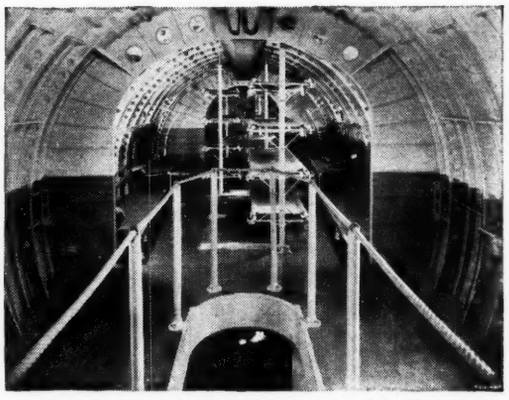

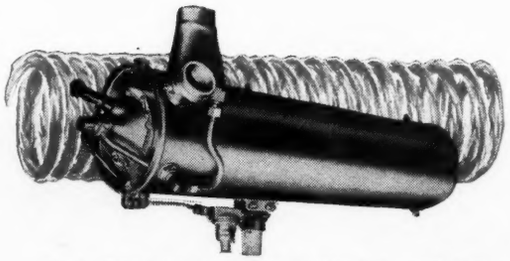

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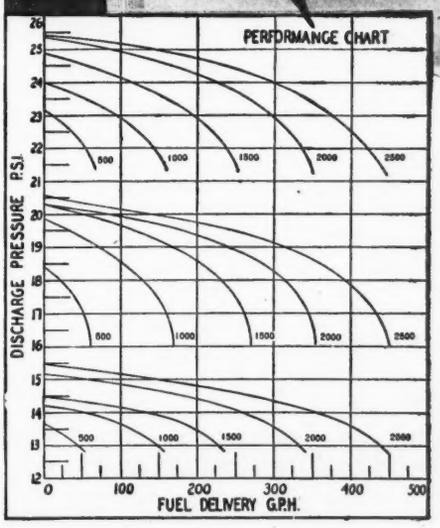

Here is a fuel pump that will be in big demand for postwar planes. With its higher pressure range of from 6 to 35 lbs., its 400 gallon per hour capacity at 2500 rpm., and its low weight of only 2¾ lbs.—It's a winner.

Built with a balanced type relief valve with shaft seals that are dependable through extreme temperature ranges. This pump is now in production.

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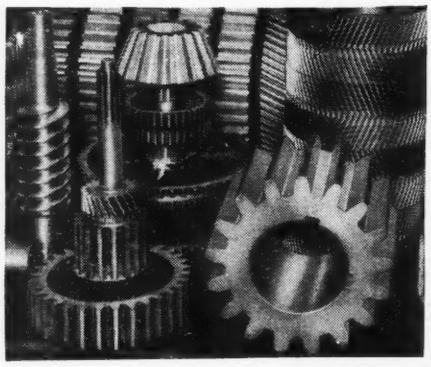

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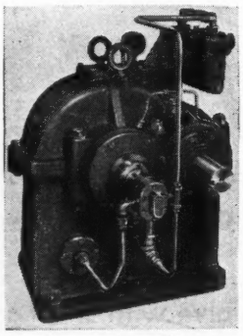

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As you start training to become an expert mechanic, choose the tools the experts use — *Plomb* tools. They are light but strong, for ease of handling and safety. They are carefully designed and balanced to work better and faster. They are expertly made of selected steels to insure accuracy and long life. These fine tools will help you learn faster, do better work, earn more money. Get the assortment shown here — from your Plomb distributor, add to it as needed from the complete Plomb line. Plomb Tool Company, 2221 H Santa Fe Ave., Los Angeles 54, California.

The VETERAN'S SET

represents careful study of apprentice requirements. Composed of 60 tools, it will handle most — if not all — the jobs encountered in the training period. The tools include: four 1/4" drive sockets and one attachment, nine 3/8" drive sockets and three attachments, sixteen 1/2" drive sockets and five attachments, eight combination wrenches, two open end wrenches, four screwdrivers, four pliers, three punches and one chisel.

RETAIL PRICE $49.98

$100.00 VETERAN'S SET ALSO AVAILABLE

You can get these tools FREE

under the Government's Apprentice Training Program. Details can be obtained from your nearest Veteran's Administration Office. And Plomb will be happy to send you its special bulletin, No. 4624, summarizing the procedure to follow and describing the tools in the Veteran's Sets.

4603

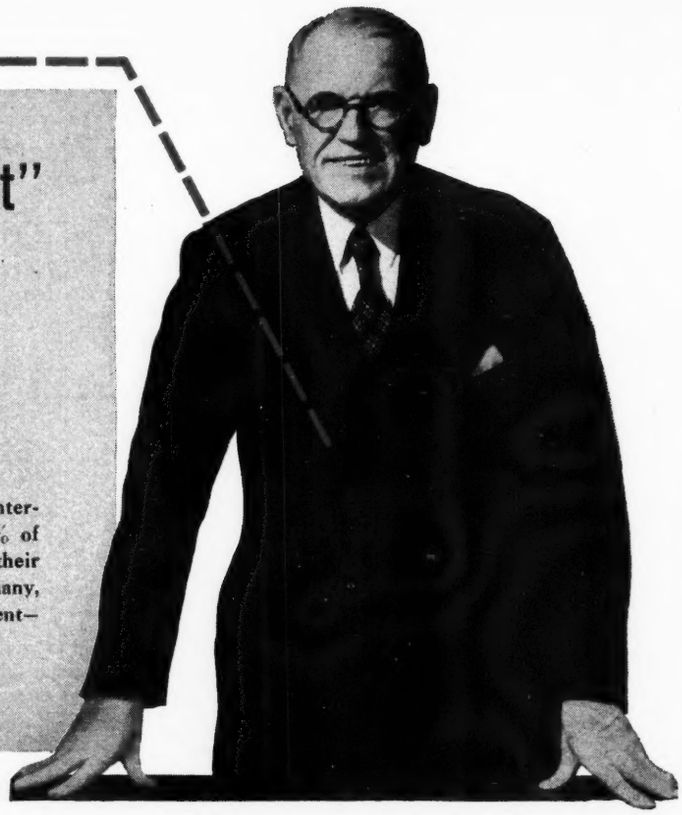
PLOMB
FINE HAND TOOLS

"Verbum sat sapienti est"

WHICH MEANS, GENTLEMEN,

"A Word to the Wise is Sufficient"

Of 161 makers of aircraft and parts recently interviewed, 66.5% already use Stainless Steel. 39% of them are planning to *increase* its application in their postwar equipment. The reasons given were many, but they can be boiled down to a simple statement—"Stainless does a better job."



WHEREVER YOU NEED HEAT RESISTANCE PLUS STAMINA WITH LIGHT WEIGHT

—nothing equals Stainless Steel!

STAINLESS STEEL offers a unique combination of many desirable properties which sets it apart as the ideal material not only for parts subjected to high temperatures but for many structural parts and control surfaces where high strength is wanted with the smallest practical size, weight and area of the part.

In exhaust stacks, collector rings, venturi cowlings, firewalls and deflection shrouds, U·S·S Stainless Steel insures better performance because of its high creep strength at elevated temperatures — because it produces no harmful oxidation scale —because it provides superior resistance to corrosion, wear and cavitation.

In aileron struts, in rudder, elevator and stabilizer frames the strength of U·S·S Stainless makes it possible to obtain high strength-weight ratios. Its high corrosion resistance eliminates the need for making allowances for weakening, adds to control efficiency. Longer life and low maintenance costs result from U·S·S Stainless' greater resistance to fatigue, shock and abrasion.

The exceptional formability of U·S·S Stainless Steel, the fact that it can be readily spot welded *at high speed,* lowers fabrication costs and permits aircraft builders to take full advantage of the latest improvements in plane design and fabrication techniques.

Remember, U·S·S Stainless Steel —a perfected, service-tested stainless —is available in the *most complete* range of sizes, forms and surface finishes anywhere obtainable. Our engineers will gladly cooperate with you in applying it most efficiently.

U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
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NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Supply Company, Chicago, *Warehouse Distributors*
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USS STAINLESS STEEL UNITED STATES STEEL

EVERY SUNDAY EVENING, United States Steel presents *The Theatre Guild on the Air.* American Broadcasting Company coast-to-coast network. Consult your newspaper for time and station.

UNITED STATES STEEL

So clearly and unmistakably are draftsmen able to express their ideas on paper that their drawings have re-shaped the world. Through line, figure and symbol, draftsmen define the work to be done by the labor and machines of a nation. Assisting them to attain precision and clarity are drafting instruments that act almost as living extensions of their own hands...instruments that function figuratively as their partners in creating.

For 78 years Keuffel & Esser Co. drafting equipment and materials have been partners, in this sense, in shaping America, in making possible its swift-moving highway traffic, its speed in conducting business, its victorious might in war ...So universally is K & E equipment used, it is self-evident that every engineering project of any magnitude has materialized with the help of K & E. Could you wish any surer guidance than this in the selection of your own "drafting partners"?

You will find special advantages, for example, in PHOENIX* Tracing Cloth, which K & E has made almost "ghost-proof." Here is a cloth from which you can erase either pencil or ink lines without risking untidy "ghosts" on the prints, a cloth practically immune to stains from perspiration and water. You can even soak it in water for ten minutes at a time without harm! For further details about PHOENIX* Tracing Cloth, write on your letterhead to Keuffel & Esser Co., Hoboken, N. J.

partners in creating

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Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules, Measuring Tapes.
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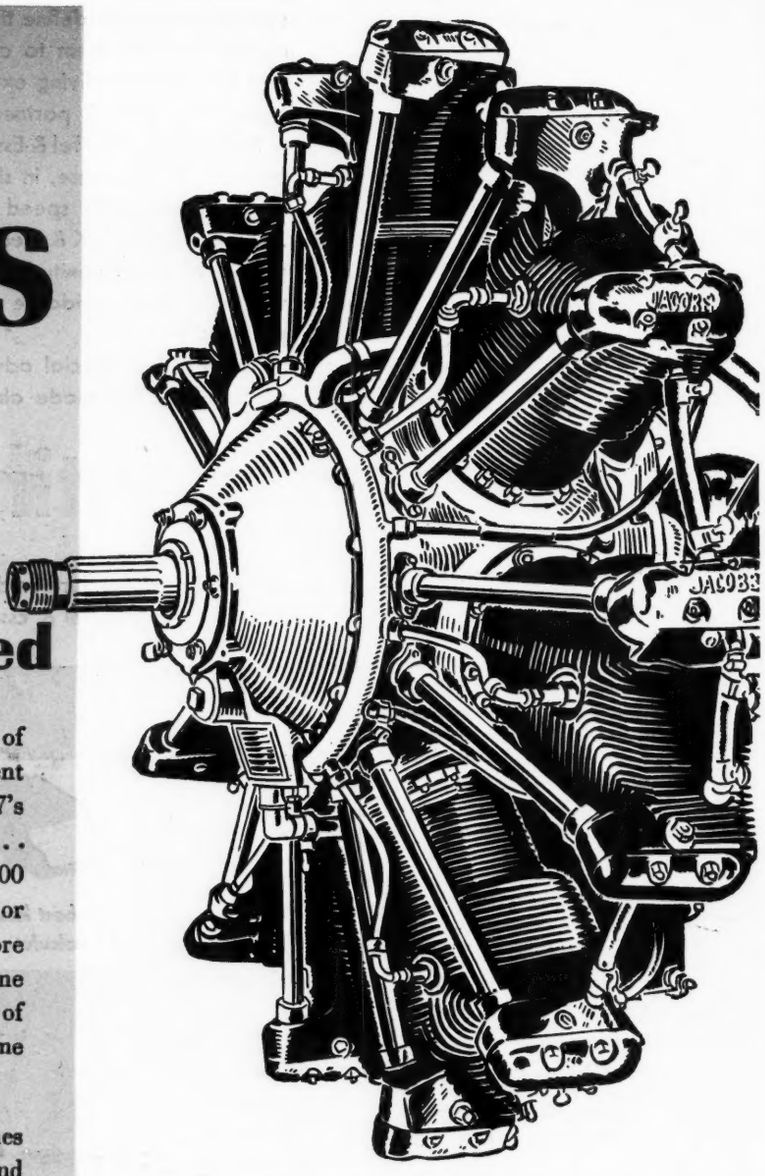
AAF Surplus

JACOBS rebuilt R755-9's

Factory guaranteed

The R755-9's are the famous "Workhorse of the Air" engines that established such magnificent performance records in the twin-engine AT-17's and UC-78's used in training bomber pilots . . . delivered hundreds of hours more than the 600 recommended by the manufacturer between major overhauls—despite grueling service, and more time at full throttle than any other service plane engines . . . Today, they are working for scores of feeder lines and transport services, flying peacetime payloads with minimum operational costs.

In the Jacobs plant at Pottstown, these engines have been completely torn down, inspected and rebuilt, with new parts installed if required. All latest modifications have been incorporated and each engine has been checked and run-in on our test stands . . . carries the manufacturer's rebuilt guarantee. Available singly or in lots, these R755-9's represent important savings over original cost for the engine that will serve dependably with less care and lower maintenance costs than any other aircraft engine in its rated class today. Immediate delivery . . . Complete information on application . . . Jacobs Aircraft Engine Company, Division of Republic Industries, Inc.

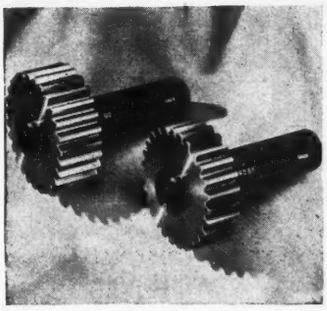


SPECIFICATIONS

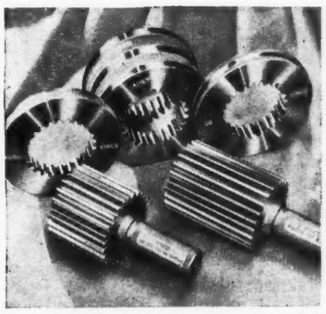
TYPE—Direct drive, seven cylinder air-cooled radial
TAKE-OFF RATING—245 bhp at 2200 rpm
NORMAL RATING—225 bhp at 2000 rpm (at sea level, on 73 octane minimum fuel)
DRY WEIGHT—510 lbs., without accessories
BORE—5.25 inches **STROKE**—5.00 inches
DISPLACEMENT—757 cubic inches
COMPRESSION RATIO—5.4 to 1
IGNITION—Magneto-battery, radio-shielded
OVERALL LENGTH—39.5 inches **DIAMETER**—44.0 inches

JACOBS • Pottstown, Pa.

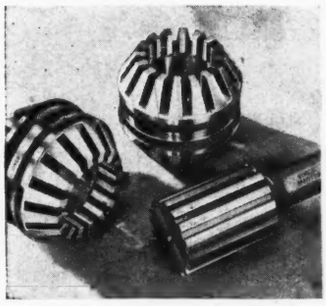
Division of Republic Industries, Inc.



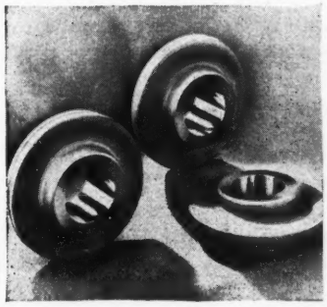
Over 50% of involute spline gages used are made by Vinco.



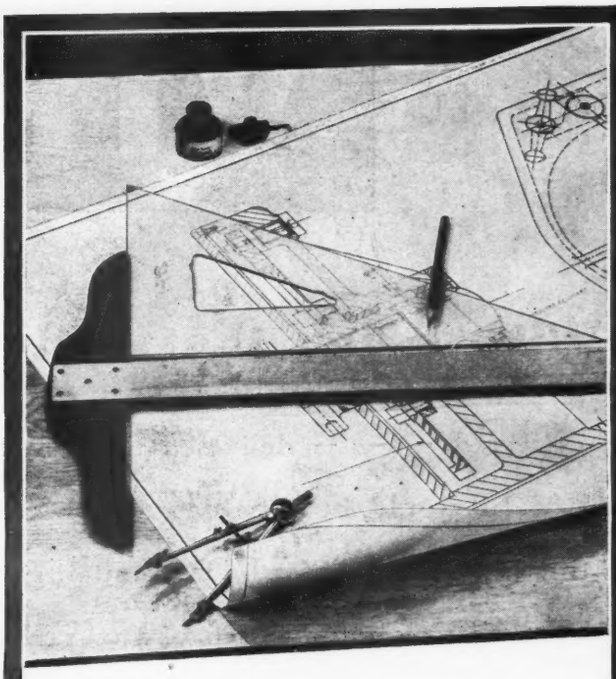
Vinco Serration Gages—standard of quality in accuracy and finish.



Accurate in every minute detail—Vinco Straight Sided Spline Gages.



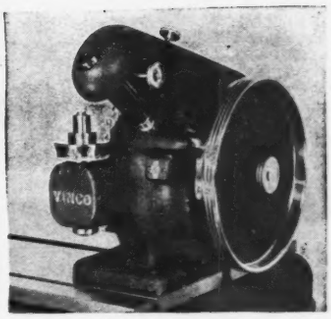
Longer life of gaging accuracy—Vinco Plain Plug and Ring Gages.



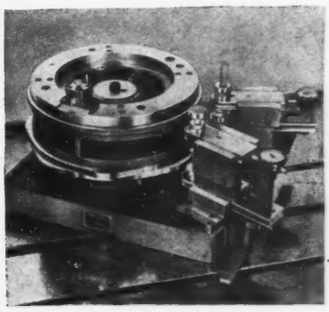
Let us take it from here on

The design may require close gaging—it could be a precision part to be subcontracted—it might need special jigs and fixtures to produce it. Whatever is required, call VINCO!

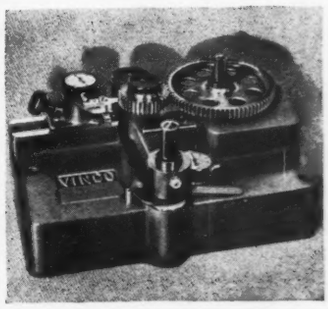
Twenty-five years of pioneering and perfecting methods of operation enables VINCO to manufacture precision products of the highest uniform quality—your assurance that any VINCO product or service will meet all specifications and conform to your particular needs. On any question of gaging, inspection control or precision production call VINCO first—it may save you both time and costly trouble.



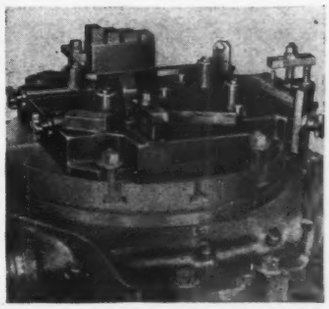
The Vinco Dividing Head—accurate checking of angular spacing.



Built-up and Special Gages—Vinco precision throughout.



Gear Rolling Inspection Fixtures—provide rapid, close check of gears.



Jigs and Fixtures—Vinco precision products made to Vinco standards.

MILLIONTHS OF AN INCH FOR SALE BY VINCO

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VINCO CORPORATION, 8865 SCHAEFER HIGHWAY, DETROIT 27, MICHIGAN; SALES OFFICES, NEW YORK, CHICAGO, CLEVELAND

Semi-Automatic Hydraulic Spline and Gear Grinder • Optical Master Inspection Dividing Head • Involute Checker • Angle Tangent to Radius Dresser • Index Plates • Precision Vises • Sine Bars • Straight-side Spline, Serration Spline, Involute Spline and Helical Spline Plug and Ring Gages • Plain Cylindrical Plug and Ring Gages • Thread Plugs, Rings and Setting Plug Gages • Spur and Helical Master Gears • Munition Gages • Propeller Shaft and Hub Gages • Built-up and Special Gages • Gear Rolling Inspection Fixtures • Indexing Fixtures • Hydraulic Power Control, Utilization and Distribution Units • Engineering, Design and Development • Precision Production Parts.

They Came to VINCO

With a job that had to be licked

We delivered — — — delivered SO well that our customer intimated he would be very happy if his competitors were kept in the dark about it; for he is producing powdered metal parts, and the accuracy and finish of the VINCO made elements are largely responsible for the decided edge he holds over competing manufacturers.

We appreciate this customer's position, so will say no more. But we are not betraying a confidence when we say that the same knowledge and skill which served him so successfully is also available to others in solving similar precision problems.

This battery of VINCO Master Involute Checkers is an essential factor in our precision production of toothed parts. They accurately show the "angle of roll" and the amount of deviation from true involute profile, thus holding scrap to an absolute minimum. Investigate the VINCO Master Involute Checker; it could be a vital cog in your production program. Detailed information furnished upon request.

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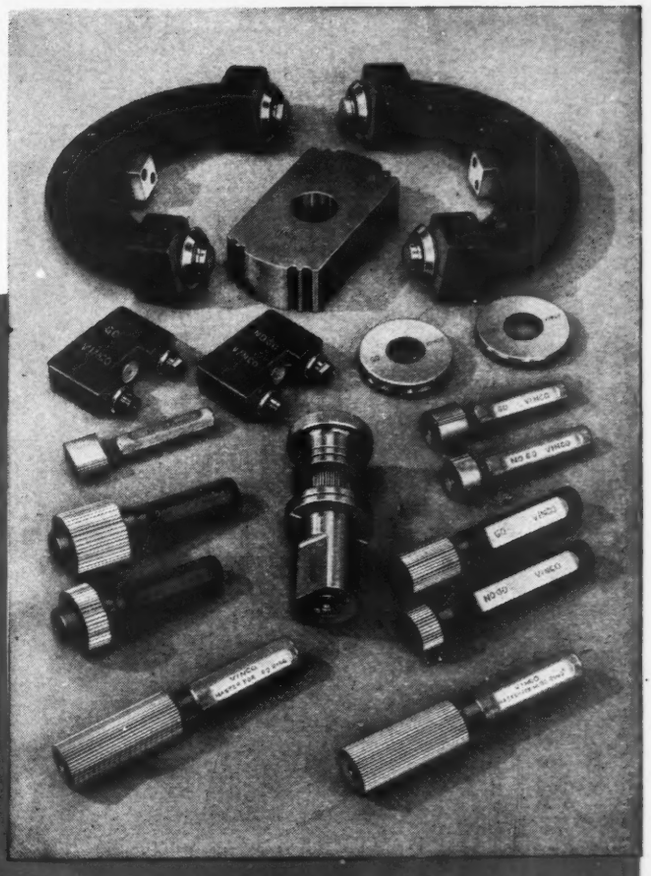
VINCO pioneered in the development of spline gaging and was the first to demonstrate the importance of an absolute control over all the essential elements of spline gages during production.

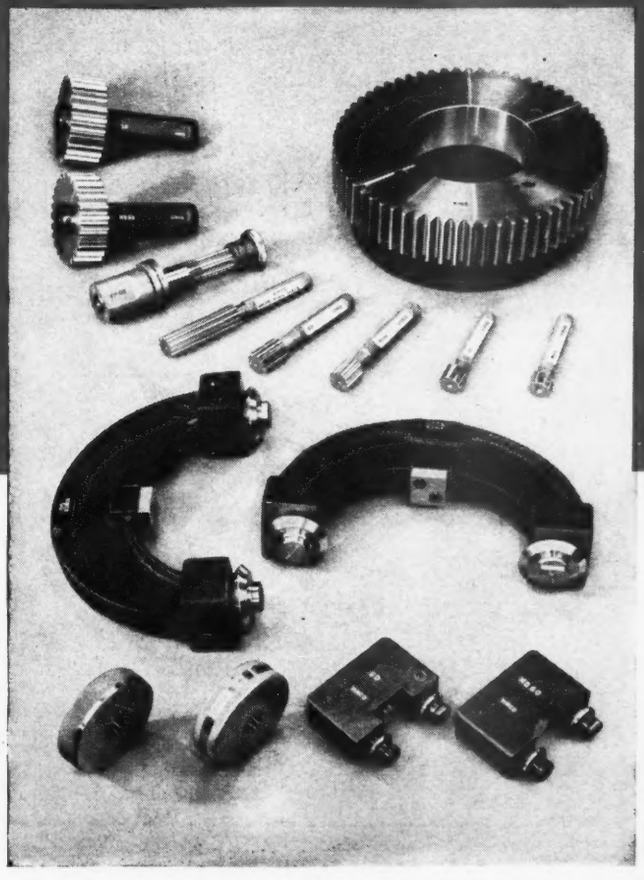
It was clearly indicated that production of splined parts depended on a clear concept of the overall gaging requirements and a proper use of the gaging equipment. Indiscriminate use of contradictory or incomplete gaging methods only created confusion during production and resulted frequently in improper assembly; a direct result of failure to establish and adhere to a proper and comprehensive gaging policy. That is why we strongly urge a thorough survey of gaging requirements before production. The only practical approach to this survey is an early consultation with gaging engineers who are specialists in analyzing and developing efficient gaging control programs for production schedules. A proven, reliable source for this highly specialized information can be found at VINCO. VINCO's Engineering Department, backed by years of study and development, is thoroughly qualified for this important service to splined parts production.

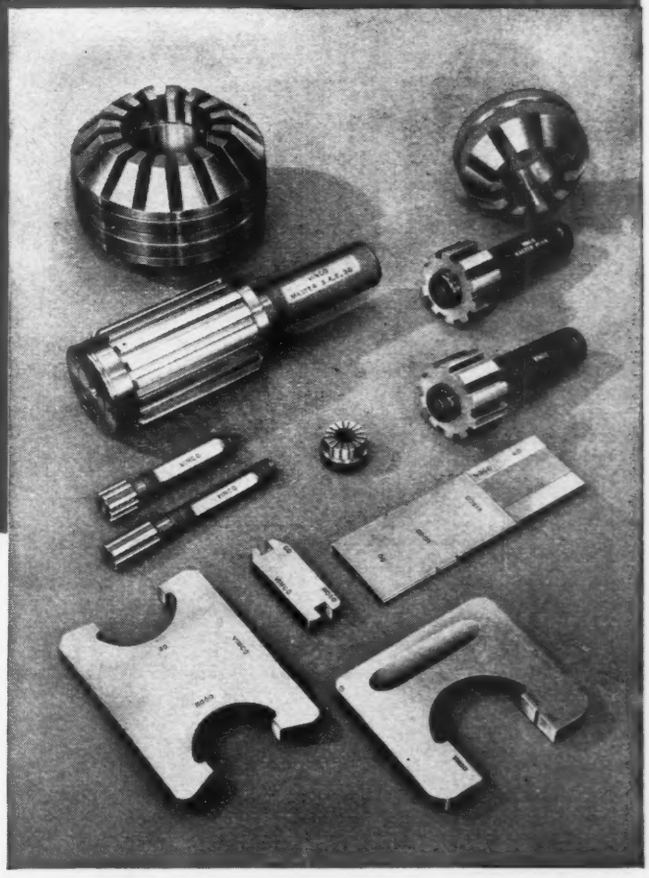
VINCO CORP. • DETROIT 27, MICHIGAN



Serration Spline Gages

Involute Spline Gages





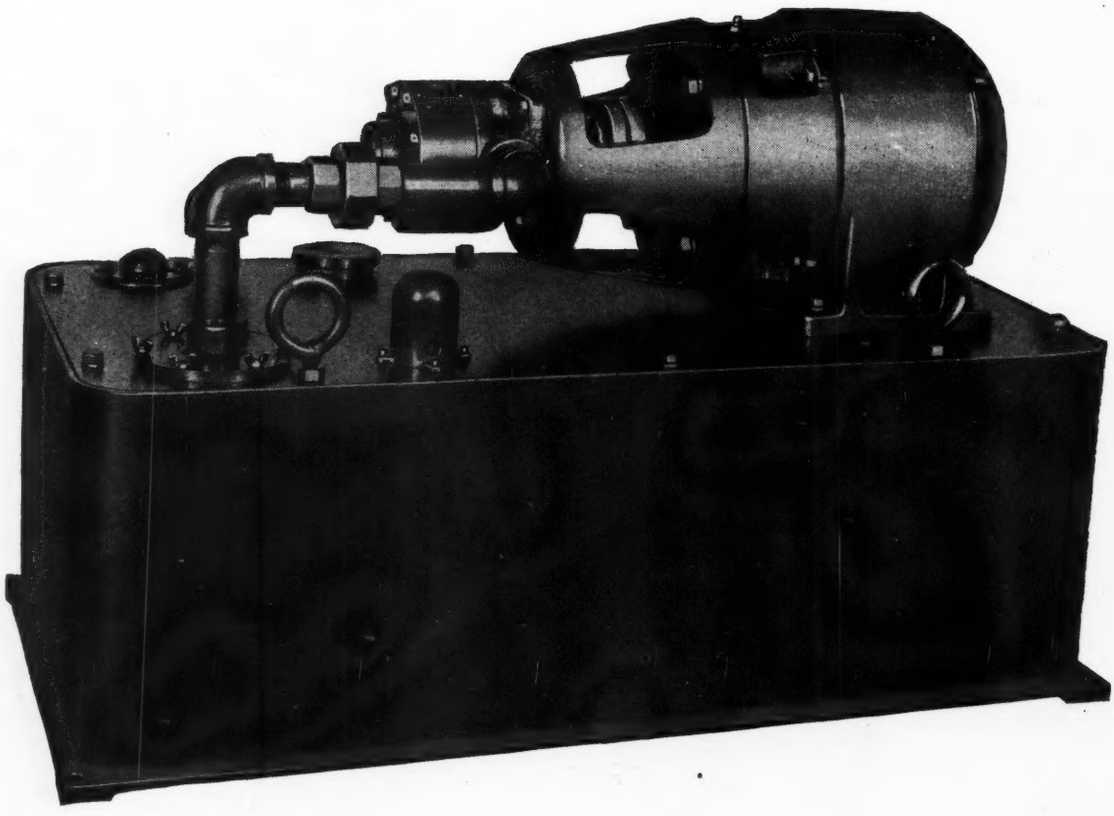
Straight Sided Spline Gages

HYCON

HYDRAULIC POWER UNITS

5 GPM TO 30 GPM

Compact Packaged Power



PUMP • MOTOR • RELIEF VALVE • PRESSURE GAUGE

on reservoir with micronic filter

For

BROACHES • MACHINE TOOLS • ROAD MACHINERY
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EXPERIENCED HYDRAULIC ENGINEERING SERVICE IS AVAILABLE

THE NEW YORK AIR BRAKE COMPANY

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420 Lexington Avenue, New York, 17, N. Y. • Factories Watertown, N. Y.

Announcing GLIDAIR Windshield Cleaner

- **CLEANS ANY TYPE AIRCRAFT WINDSHIELD *BETTER!***
- **LEAVES SURFACE DRY—FREE OF OILY FILM!**
- **HELPS PREVENT CHECKING AND CRACKING!**
- **RESTORES FLEXIBILITY AND VISIBILITY!**

GLIDDEN research brings you another winner! Proved superior to any existing cleaner in exhaustive tests, Glidair Windshield Cleaner now joins the Glidair line of aircraft products as an important contribution to safer flying.

Consider these demonstrated *facts* about this new material: It cleans any type of aircraft windshield *better,* principally because it leaves the surface dry, free of any oily, visibility-impairing film. It contains special ingredients that help prevent windshield checking and cracking and actually restore flexibility and visibility. It requires less shaking before use. Its suspended materials settle more slowly and, on settling, remain soft instead of packing.

Get this superior cleaner soon—from your nearest Glidair Distributor listed below. Consult your Distributor, too, for information on Glidair Aircraft Finishes—and for expert help on any Aircraft Finishing problem.

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GLIDAIR FLYING COLORS

Made by **Glidden** Pacemaker in Paints

For Passenger Comfort in aircraft . . . there is no substitute for ANEMOSTAT AIR-DIFFUSERS

Type W ANEMOSTAT (at right) is used near floor level for aircraft heating. Ceiling-type ANEMOSTAT (below) is used for ventilating and air-conditioning.

During the last 25 years, close to one million (1,000,000) ANEMOSTAT draftless air-diffusers have been installed on heating, ventilating, and air-conditioning systems . . .

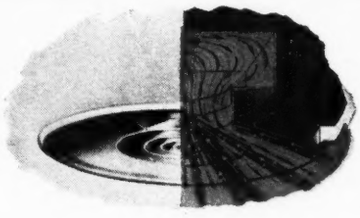
Experience in installing these patented devices on almost all types of aircraft—from commercial planes to 36 war plane models—enables ANEMOSTAT to provide constant equalization of temperature—*without drafts*—in aircraft heating, ventilating, and air-conditioning.

A great variety of air-diffusion patterns are necessary to meet the different and ever-changing needs of passenger quarters, cargo spaces, flight decks . . . Each new aircraft design needs an individually engineered air-diffuser and air-diffuser installation. That's why *there is no substitute for ANEMOSTAT air-diffusion* in aircraft heating, ventilating, and air-conditioning . . .

Only an organization devoted exclusively to solving the intricate problems of air-diffusion—as ANEMOSTAT has been doing for over 25 years—can provide aircraft with close temperature equalization and draft-free air.

ANEMOSTAT air-diffusers are already incorporated in the new designs and equipment of many leading airlines.

Write for complete details—today!



HOW ANEMOSTATS DISTRIBUTE INCOMING AIR

Due to its patented design, the ANEMOSTAT distributes air of any duct velocity in a multiplicity of planes traveling in all directions. Simultaneously, the unit creates a series of counter-currents which siphon *into the device* cabin-air equal to about 35% of the volume of supply-air. This cabin-air is mixed with the supply-air within the diffuser *before* the air-mixture is discharged into the cabin. The velocity of the discharged air is instantly reduced by air expansion within the ANEMOSTAT.

In this way, the ANEMOSTAT diffuses air of any duct velocity *noiselessly and evenly, thoroughly and draftlessly* throughout the cabin . . . closely equalizes temperature and humidity . . . and prevents stratification.

Veteran-ize your personnel!

Many discharged war veterans received valuable technical and specialized training. Always consider veterans when you employ. They did their share—now let's all do ours!

AC—1053

ANEMOSTAT

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ANEMOSTAT CORPORATION OF AMERICA
10 East 39th Street, New York 16, N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES

"NO VENTILATING OR AIR-CONDITIONING SYSTEM IS BETTER THAN ITS AIR-DISTRIBUTION"

PACKARD
High-Altitude Aircraft Ignition Cable

Look inside the tough synthetic rubber sheath of this superior cable. You will find an impregnated inner braid of glass-yarn. And there you have the reason for its greater mechanical strength and exceptional resistance to corona. Proved under extreme combat conditions, Packard high-altitude aircraft ignition cable will withstand heat, cold, oil and moisture to a far more adverse degree than you may expect to encounter. Available with either a steel or a copper conductor, it is RIGHT for *any* aircraft need.

Packard
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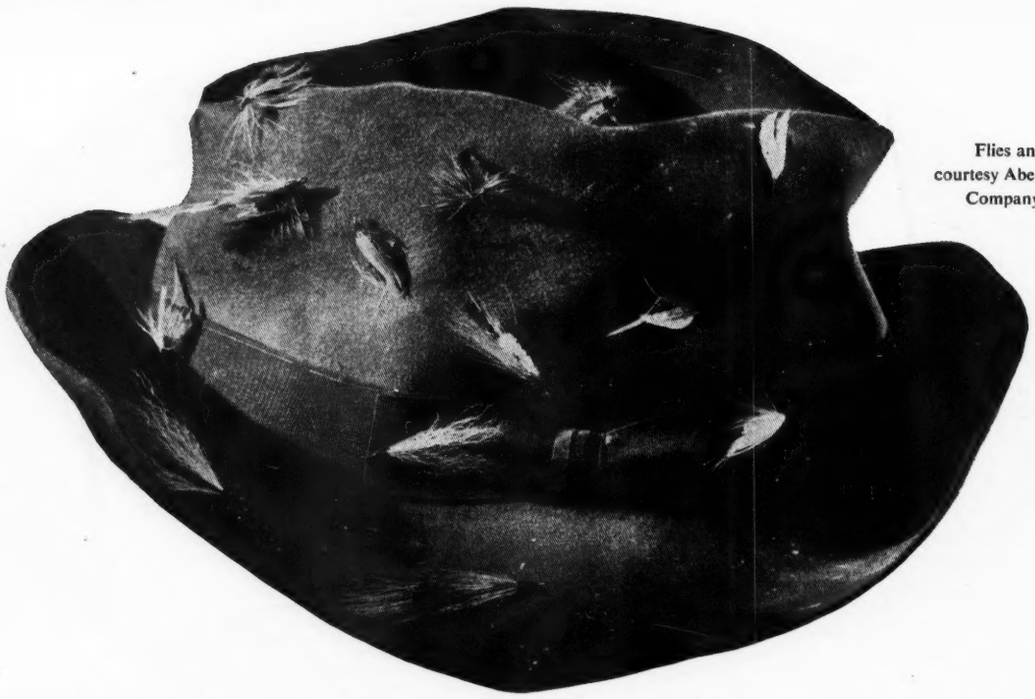
TRADE MARK

Packard Electric Division, General Motors Corporation, Warren, Ohio

How Up-To-Date are you on ALUMINUM?



Flies and streamers, courtesy Abercrombie & Fitch Company, New York.

WHICH FLY FOR THE CAST?

PARMACHENE BELLE, Royal Coachman, Grey Hackle, Silver Doctor . . . the skilled angler goes over all his flies, attempts to match fish and conditions before casting.

Nowadays the expert designer does much the same; with scientific care, he goes over the entire field of materials, rechecks the list of aluminum alloys, chooses a specific alloy, in a specific temper and form—*matches the alloy to the job and special requirements.*

For example, a manufacturer of roofing for use in smoke-laden atmospheres, may want strength with lightness . . . plus high corrosion-resistance.

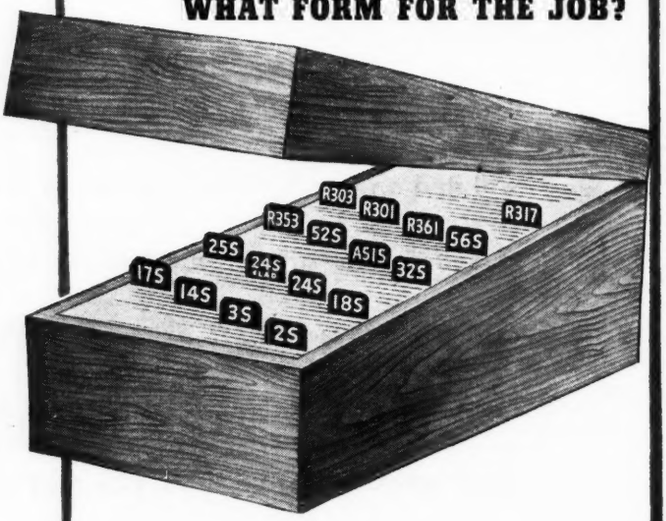
Another manufacturer, his product for indoor use, may require a high strength-to-weight ratio; he has no interest in corrosion-resistance.

In every case, there is a *right* Reynolds Aluminum alloy to use, available in various tempers and forms. Its selection is highly important, for it means a better, more serviceable product at lower cost.

Consider Aluminum . . . Consult Reynolds

Whatever your interest, Reynolds technicians are ready to co-operate with your engineers. Offices in principal cities. Phone nearest office or write Reynolds Metals Co., Aluminum Div., 2536 So. Third St., Louisville 1, Ky.

WHAT ALLOY? WHAT TEMPER? WHAT FORM FOR THE JOB?



Match the alloy to the job, obtaining also the temper needed in the form best adapted to your production.

REYNOLDS METALS

REYNOLDS ALUMINUM

The Great New Source of

INGOT · SHEET · SHAPES · WIRE · ROD · BAR · TUBING · PARTS · FORGINGS · CASTINGS · FOIL · POWDER

ENGLISH FIELD, *Amarillo, Texas*

"THE FRIENDLY FIELD" IS A GOOD FRIEND OF PHILLIPS!

Airline Terminal Building, which houses operations, ticketing, and reservation offices for Braniff Airways, Inc., Essair, Inc., and Transcontinental & Western Air, Inc.; C. A. A. Communications Station; U. S. Weather Bureau Station; a Coffee Shop and Dining Room.

FOLKS who fly the Southwest will tell you that for courteous, personal service and friendly goodwill, there's no place that can beat English Field at Amarillo!

Blessed with excellent terrain and a high percentage of flying weather, its modern facilities serve an increasing number of private planes.

In addition, English Field handles four scheduled flights of Braniff Airways, Inc. per day; and an average of twenty-six flights of Transcontinental & Western Air, Inc. per day.

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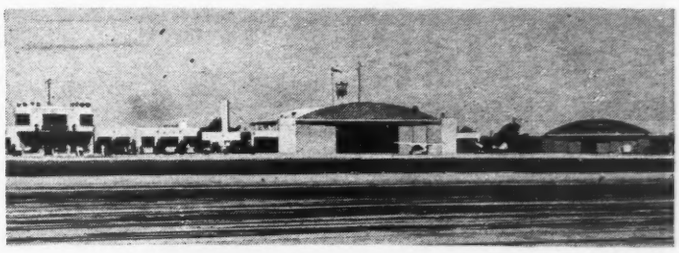

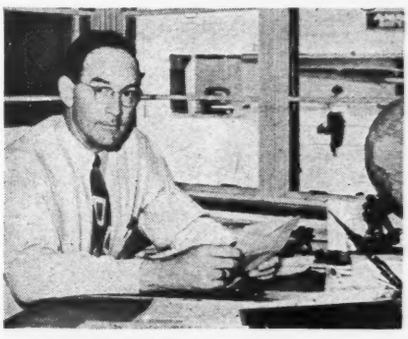

Above—Panorama of buildings on English Field showing, from left to right, Airline Terminal Building, Private Fliers Terminal Building, Hangar No. 1, and Hangar No. 2.

At left—C. H. Knupp, one of the people who helped make English "the friendly field" has been Airport Manager for the past 11 years.

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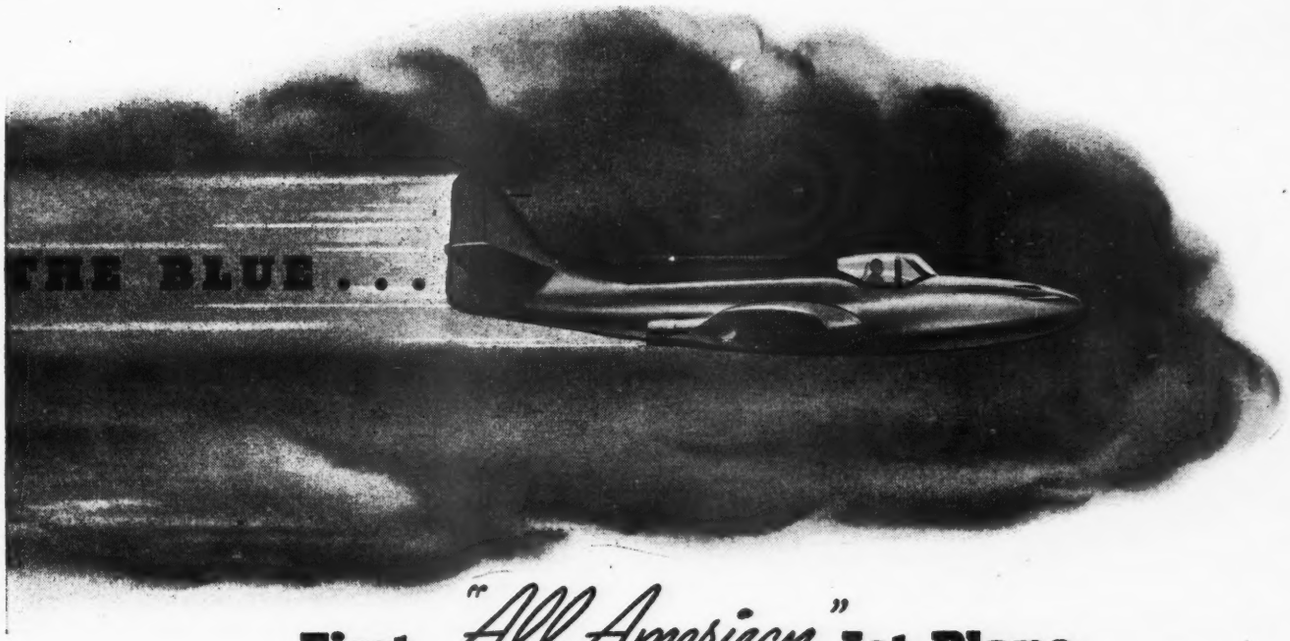
A NEW "Phantom" STREAKS

Two Westinghouse "Yankee" 19-B's power the McDonnell FD-1—the Navy's newest interceptor.



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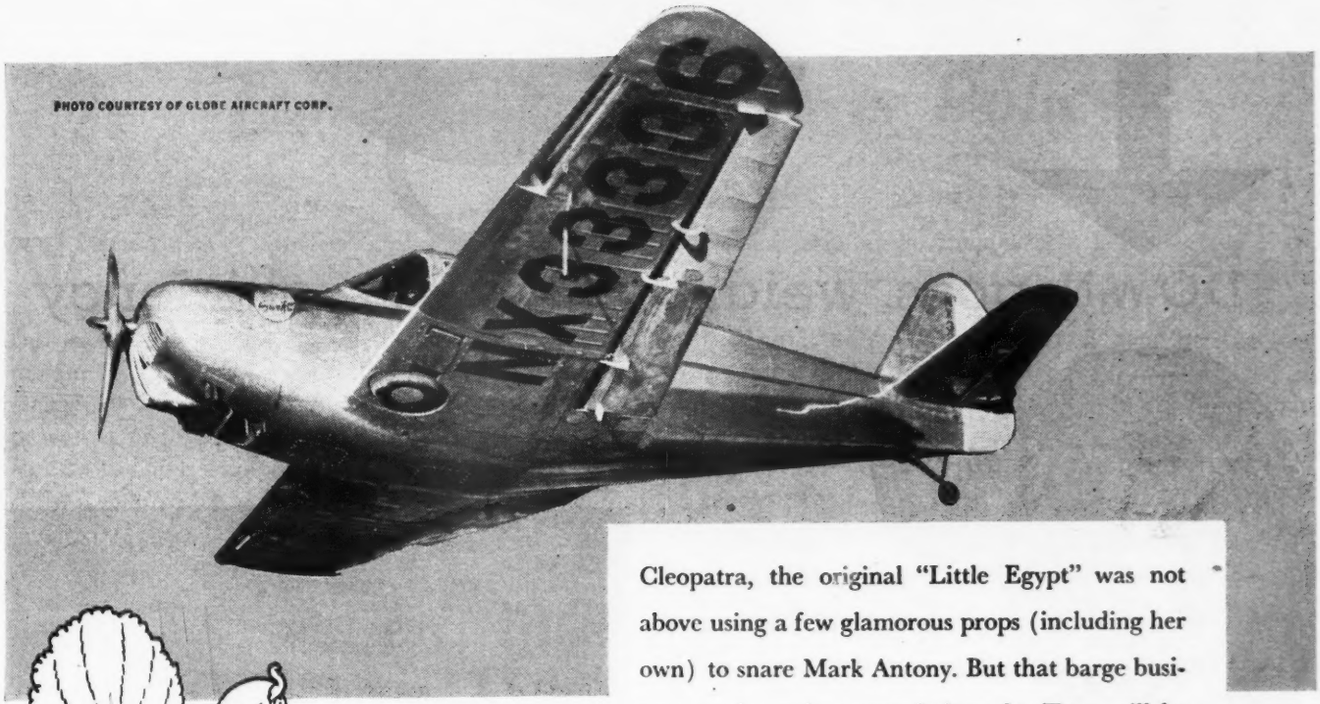

Cleopatra, the original "Little Egypt" was not above using a few glamorous props (including her own) to snare Mark Antony. But that barge business won't work a second time, for Tony will be thinking seriously about going places with another trim number . . . probably one like this sleek Swift.

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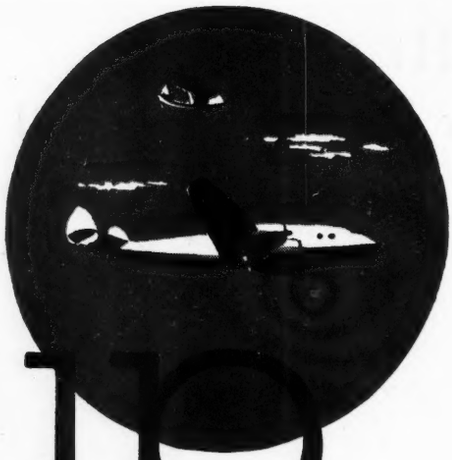

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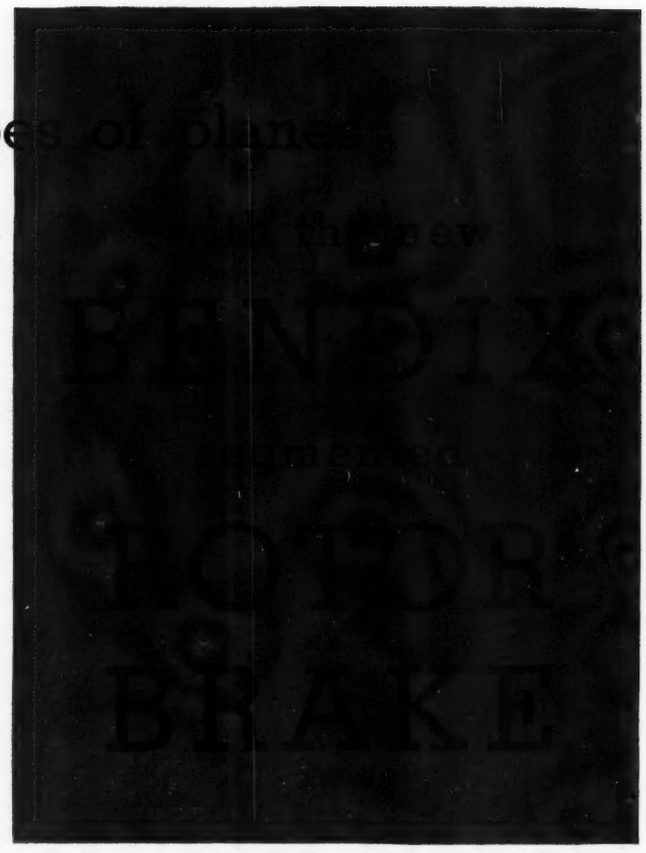

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EDITORIAL

Here's a Vital Step Toward an Air Power Policy

WHEN GERMANY COLLAPSED it became apparent that a Japanese defeat soon afterward would have devastating effects upon our national economy. Our consciousness of this fact did not deter us for an instant from all out effort to bring the conflict to conclusion. V-J Day caught us woefully unprepared for peace. And so began that period which historians may rightfully name "the great American holiday".

Now nearly nine months have passed and the holiday is still going on. Inflated money still burns holes in people's pockets. Airlines, railroad trains, buses and hotels are full of pleasure seekers. It would seem that only the pangs of hunger will provide the incentive to send them back to work.

Fortunately for America there were some people and some industries that realized the importance of uninterrupted productivity. The aircraft manufacturing industry was one. It realized that there would be no holidays in military aircraft manufacturing in other nations. It foresaw the folly of too rapid demobilization of our once dominant air power in a world whose national differences are far from settled. Wisely the President invoked his war powers to direct the Army and the Navy to issue a sufficient number of experimental and procurement contracts to preserve the bare framework of the military aviation industry. But an industry whose existence depends upon peacetime Presidential directive is in a most precarious position. It possesses no firm foundation upon which to build its future plans.

THE PUBLIC and some segments of the Congress have looked upon military aviation manufacturing as the mere fabrication of weapons. They have been generally unconscious of the years of research and development which precede production, the rapidly changing technology of aviation and the contribution that aviation manufacturing could make toward a healthier national economy.

This narrow view is not shared by our wartime allies. In Britain the postwar aircraft procurement programs are larger than our own. Only recently Premier Stalin announced that Russian aircraft production would continue at high levels. Incidentally, leisure-loving citizens might well take a lesson from the realistic Russians in their appreciation of the importance of productivity.

Within the past few weeks new hope for the future of military aviation and the national security has appeared in the form of the Mitchell Bill. Senator Mitchell and his immediate colleagues have realized the urgent need for a national air policy. The bill, which is reproduced in part on page 40, provides for formation of an impartial, non-partisan board to evaluate our air power needs and to recommend a long term program to fulfill them. Its functions would be similar to those of the Morrow Board which gave the nation its first air power policy in 1925.

THIS APPROACH to our air power problem was advocated in these pages more than a year ago while we were still at war. It was emphasized in feature articles by Eugene E. Wilson published in AVIATION (January and February 1945). These cogent articles became chapters in Mr. Wilson's book, "Air Power for Peace", which was recently reprinted in a new and revised version. Between the covers of this compact volume are the fundamental principles upon which our future air policy should be based. In the pages immediately following are some of Mr. Wilson's most recent thoughts on air power policy. This material is offered at this time in the hope that it will assist all of those who share the grave responsibility of creating future air policy.

During this critical period of experimentation toward the perfection of the society of nations it is important that we reflect deeply on these thoughts. It is the first job for everyone in the aviation industry to support Senator Mitchell in his efforts to take the first step toward creation of sound air power policy. Preservation of our aircraft industry and the other elements of air power is only incidental to the preservation of the security of our civilization.

Leslie E. Neville

EDITOR

Talk of military unification has side-tracked sorely needed progress toward getting this country's aeronautic program clearly stated and under way. But, says this industry spokesman, any armed service merger or reorganization should follow, and he shows here why—

ACTION ON THAT AIR POLICY IS THE NO. 1 MUST

By **EUGENE E. WILSON,** *Vice Chairman, United Aircraft Corp., and Chairman, Aircraft Industries Assn.*

JUST TWO YEARS AGO, when there was still great pressure for increased war production, the presidents of the 17 major aircraft manufacturing companies managed a short "time out" gathering in Los Angeles to put an eye on the future.

Most of these men had personally experienced the debacle which followed World War I, when a disorderly termination of war contracts destroyed the aircraft industry and paved a pathway of troubles into World War II. All of these men felt it their responsibility to do what they could to prevent a repetition of the debacle. Each knew that no matter how good an individual job each company might do during the war, the chances of any company surviving a disorderly conversion were remote indeed.

Above all, these men recognized their public responsibility to join hands to work toward the preservation of American Air Power.

The first step was to agree upon a statement of policy; the second step was to reorganize their trade association with a view to implementing the policy decided upon. They clearly recognized that no policy can be effective unless it is founded on public support. Their major objective was, therefore, to give the widest possible publicity to their program with a view to enlisting public support.

While much of the work in the national field could be done by the association, the effort in the grass roots had to be done by the company presidents themselves. This comprised special promotion handled through company publicity and advertising organizations, the programs being beamed to reach the manufacturer's own employees and their immediate neighbors.

This public relations program was carried on quite successfully in the face of severe competition. Cataclysmic events were in the news. Against this sort of background it was difficult to get public attention on such a prosaic thing as a policy. However, the industry had an extraordinary record of accomplishment to give strength to its voice. Public interest in aviation was still intense. The policy was sound. And it had strong appeal from the point of creating new jobs, new enterprises, and new wealth.

In any event, great public interest *was* aroused in the subject, and opinion-forming groups soon expressed general agreement on the need for a re-delineation of an American Air Power Policy.

The manufacturers were virtually unanimous in their conviction that this re-statement of policy should come out of another Presidential Advisory Committee similar to that held under the chairmanship of Dwight Morrow in the Coolidge administration in 1925. This policy —which became implemented in the Air Corps Act of 1926 and the Air Commerce Act of the same and subsequent years— predicated the development of the art into the future from those days 20 yr. ago.

Since then, i.e., in World War II, the Air Forces have proven themselves militarily decisive. More important, the airplane had emerged as a revolutionary vehicle of transport. Air Commerce offered a constructive means of promoting trade and industry and thus breaking down misunderstandings and maladjustments that sow seeds of war.

While a re-statement of policy might have been made by the Administration, the manufacturers were convinced that public support could only come out of the dissemination of information before a public forum. They, therefore, set as their goal the appointment of such a Presidential Advisory Committee.

By the end of the first year it appeared entirely possible that such a committee might be appointed. Then sand got into the gear box somewhere. Different government agencies had different opinions as to the usefulness of such a committee. Some felt that we already had an adequate air policy and that to open the question would only serve to rock the boat. The Navy supported the idea, but the Army Air Forces apparently believed that this support constituted "delaying tactics" by which the Navy sought to delay the so-called unification of the Services. And since the Administration was unlikely to support any proposal that did not have the unanimous consent of interested parties, nothing happened.

Meanwhile, the war was rapidly coming to a close. Under the law, all war contracts were subject to cancellation with the termination of hostilities. The only saving grace was the authority vested in the President (by Section 202 of the Reconversion Act) to continue in effect such contracts as were in the public interest. Save for the prompt action of the Army, Navy, and the War Production Board, the American aircraft industry might have found itself without any business on V-J Day. Thanks, however, to their initiative and to that of Reconversion Director Snyder and President Truman, certain vitally necessary contracts were continued. These were principally research and development orders, along with limited production on the most advanced types of craft.

Meanwhile, impressive evidence had been presented to supply a firm foundation upon which the vitally needed new Air Power Policy could be delineated. This evidence in itself clearly outlined the requirements of the policy, then charted the course which the nation should follow. But it was so detailed and voluminous and, moreover, had been offered in so many varying forms, that

it became imperative that it be brought into focus for projection against the future. Among the most outstanding contributions we can list the following:

1. Report of Air Coordinating Committee.
2. Biennial Report of Chief of Staff of United States Army to Secretary of War.
3. Final Report of Chief of Naval Operations to Secretary of Navy.
4. Third Report of Commanding General of Army Air Forces to Secretary of War.
5. National Planning Assn.'s recommendations on National Aviation Policy.
6. Testimony submitted to Aviation Sub-Committee of Mead Special Committee investigating National Defense Program.
7. Testimony submitted to joint hearings on proposed National Research Foundation legislation, and before Senate Atomic Committee and House Military Affairs Committee.
8. Hearings of House Committee on Naval Affairs on subject of composition of postwar Navy.
9. Hearings before House Select Committee on Postwar Military Policy.
10. Accumulation of evidence by planning echelons of Army and Navy.

Instead of getting this working material crystallized into its proper elements from which to chart a sound and effective policy which Congress and all the agencies might follow, we fell into the inevitable controversy on "unification." One might have thought that a more rational course would have been first to adopt the policy and second decide the administrative organization necessary to carry it out.

However, we got the cart before the horse, and accordingly all considerations of the policy were sidetracked while each of the protagonists battled either for political or tactical advantage. Such problems as federal participation in airport development, regulation of rates on international air transport, coordination of scientific research and technological development, programs of expenditures of public funds, disposal of surplus plants and aircraft, and many other things, bogged down in a welter of complicating opinions.

Clarity vs. Diversity

Many different agencies of the government now have cognizance of aviation. Each of these looks at its problems from its own vantage point. None has responsibility for the whole. In Congress, several different committees have cognizance of the different sections of the problem, and there has been jockeying for control. The one thing all these agencies need to facilitate progress is a clear statement of overall Air Power Policy.

Where legislation is required, such a statement should promote passage by focusing public attention upon the problem. Where legislation is already in force, such a statement would facilitate administration by defining overall objectives and enlisting public support. In all this, public understanding of the problem and support for the objectives would seem to be the chief reason for making a real statement of Air Policy.

Meanwhile, however, spectacular scientific progress has tended to obscure underlying truths. People are presuming that the atomic bomb has done away with land power, sea power, and air power. They forget that the new science is no substitute for ground, seaborne, or air forces. They miss the point that it is only an instrument of these forces. This tends to further obscure the true fundamentals of our power position.

It is most unfortunate that it has obscured the most revolutionary development in the recent history of mankind: The really great advance of this period of history is the emergence of the airplane as a new form of transport and thus a new vehicle of commerce. Here is an instrument which could be utilized to accelerate trade and create new jobs and new wealth, thus speeding the recovery of a war-torn world. This recovery, in turn, is about the only process that can be expected to clear up the suspicions and misunderstandings and remove the maladjustments that now sow seeds of war. However, freedom-to-trade presupposes peace. It also recognizes a guarantee of the right of innocent passage to all who proceed on their lawful occasions. The Air Force, or the Air Force contingents called for in Section 45 of the San Francisco Conference, are designed to make secure freedom of communication by air. Scientific research and technological development are the keys to the leadership in military and

The bitter lesson of history—which Author Wilson says is dangerously close to repetition as nation flounders without a sound air policy. Lack of such policy following World War I practically wrecked aviation industry, which meant that only craft available for airmail were such obsolete planes as these DH-4s. Holdover '4s were still used into late '20s. And engines, like old OXs, persisted into '30s.

transport aircraft, the whole being centered in the aircraft industry.

The aircraft industry is, therefore, the keystone to the air power arch, which includes on one hand the Air Force and on the other Air Commerce. Air Power in all three aspects offers opportunities in the creation of new wealth, new enterprise, and new jobs—not alone in the realms of aviation but in all other fields of human endeavor. Air Power is the great new medium by which new science can be directed into channels leading to restoration of world peace and prosperity. That would be the objective of the U. S. Air Power Policy.

Meanwhile, however, we have moved with breath-taking speed in exactly the same direction which we moved following World War I. While our manufacturing industry has a short lease on life as a result of the actions we have indicated, it still must face the long term problems of great magnitude. In spite of the proof that our efforts toward disarmament were responsible for World War II there are at present in high places those who believe we should try this panacea again. At this rate the aircraft manufacturers, who through their resourcefulness and versatility made it possible to preserve our freedom, will once more be called war mongers and merchants of death. Unless steps are taken at an early date—to reaffirm an American Air Power Policy and to continue to execute it—World War III is inevitable, and could come sooner than we think.

Surely it would not seem to be a difficult task to state clearly and simply an outline for an American Air Power Policy. It might read like this:

In the interest of promoting world peace, and in order to "establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty to ourselves and our posterity", it is the policy of this Administration:

1. To accelerate the orderly and economic expansion of domestic and international air transport and of private flying to the end that trade and commerce may expand, new enterprises may develop, new employment may be created, and world prosperity be restored.
2. To maintain the aviation establishment of our Air, Ground, and Sea forces at such strength and in such state of readiness as to discharge our responsibilities under the San Francisco Convention to keep the peace and preclude a successful assault upon our country.
3. To foster technological leadership in the air through a coordinated, long-term, continuing program of industrial research, experiment, and procurement designed to preserve a superior private aircraft industry capable of rapid expansion in emergency.

This is something which everyone in aviation can wholeheartedly support. The time has come when everybody in aviation must do just that. If the many different organizations in American aviation could spend about one-tenth as much effort in support of an overall Air Power Policy as they spend trying to unravel the conflicts which result from the lack of such policy, the problem would be solved.

What we say here is intended to be a clarion call for all of the public and private agencies concerned with aviation to get behind a program. Out of our experience, we manufacturers are certain that a Presidential Advisory Committee is essential not only to long term interests of American aviation but also to our national security. If we can't get agreement on that we can at least get agreement on a statement of Administration policy on the subject. It is high time we concentrated our efforts upon this.

An Approach to an Air Power Policy

PRIMARILY INTENDED to establish a National Air Policy Board which would make thorough investigation of aviation's relation to defense. Bill S.1639 was introduced last Dec. 3 by Senator Hugh B. Mitchell and referred, after two readings, to the Committee on Interstate Commerce. To implement its aim, the measure asks that a special eight-section Title IV be appended, via amendment, to the Transportation Act of 1940.

Meaningful lines of investigation are specifically indicated in the bill, with attention of the proposed Board being directed to careful consideration of—

1. Government policies that should be adopted to stimulate a healthy rate of technical progress in air transportation.

2. Coordination and organization of the military and naval air forces and Government agencies concerned with aviation and transportation.

3. The size of peacetime air forces necessary to the national defense.

4. Maintenance of a properly balanced and expansible productive capacity of aircraft in peacetime.

5. The extent, if any, to which plans for future wartime expansion should rely upon peacetime aircraft production companies; the extent, if any, to which such expansion should involve conversion of the automobile and other non-aircraft industries; and the extent, if any, to which civil aviation and aircraft exports should support a peacetime aircraft industry.

6. Suggestions for the conversion of aircraft production from a wartime to a peacetime basis, so as to assure the preservation of an aircraft production industry adequate to meet the transportation and national defense needs of the future.

7. Means of effectively utilizing new modes and improvements to existing modes of air transportation developed during the war.

8. The coordination, strengthening, and preservation of a national transportation system by water, highway, rail, and air adequate to meet the needs of the commerce of the United States, both interstate and foreign.

In the terms of the bill, the Board would comprise nine members named by the President with advice and consent of the Senate, with the President designating the chairman of the Board and the Board itself electing the vice chairman. A majority of the Board would constitute a quorum, and the powers conferred would be exercised by majority vote.

It is further stated that the Board would be authorized to employ experts, special agents, examiners, attorneys, etc., as it deems necessary; also that it would be enabled to utilize services, information, personnel, etc., of various Governmental agencies and departments to the extent that the latter find no undue interference with the performance of their own work.

The Board would have the power to hold hearings and to require by subpena, or otherwise, the attendance of witnesses, along with essential papers and documents.

Reports of the Board's investigations, findings, and recommendations are asked not later than three months after activation of the new body, with printing of the material as a public document for use of the Senate Committee on Interstate Commerce, the House Committee on Interstate & Foreign Commerce, and such other committees of Congress which might find the information relevant.

Life of the Board is specified as one year, with a sum of $15,000 authorized for carrying out the work. It is, of course, recognized by proponents that more time and more money would likely be needed to do the job right, but nevertheless this authorization would give the much-needed initial impetus to the air policy project.

* A "freshman" in the Upper House—he took his seat in Jan. 1945—39-yr.-old Senator Mitchell is a State of Washington Democrat. Initially a newspaperman, he acted as executive assistant to Congressman Wallgren, 1933-1941, then continued in this same capacity during the latter's Senatorship of 1941-1945. When Wallgren resigned from the Senate in 1945 to become Governor of Washington, he appointed Mitchell to fill his vacancy.

How long must promising air cargo potentials lie fallow because inapt precepts won't permit essential development in this favorable field? Posing that as a No. 1 question, Analyst Frederick advises sharp revision in CAB regulations to clear the skyfreight runways, his contention being that we should —

"Rank Cargo Carriers on Their Own"

By **JOHN H. FREDERICK,** *Professor of Transportation, University of Texas*

AS AIR TRANSPORTATION DEVELOPS, it seems certain that more and more air-cargo carriers will go into operation as businesses separate from the conventional airlines. These carriers will operate in the contract, private, or other non-scheduled fields. They are seen playing essential roles because they offer these advantages:

1. "Tailored" services for shippers. Working in close association with shippers, the air-cargo carriers will be able to tailor their services to fit specific needs. Moreover, they will be able to operate at lower rates.

2. Flight flexibility. Air-cargo carriers will provide flexibility of flight service (which the shipper requires), since these cargo flights will not be held to the usual type of air-service schedule restrictions.

3. Direct routing. Air-cargo carriers will fly the most direct routes, which is not always possible for the conventional airlines (the latter naturally deviate from the straight line in their multi-stop flight courses which serve major centers of population; furthermore, they are required to hold to the routes for which they are certificated). The shortest, or great circle, routes of the air-cargo carriers are particularly important in the flying of perishables in order to cut down costs and possible losses.

4. Accommodation to changes. Air-cargo carriers will be able to accommodate to the needs of shippers as, from time to time, points of origin and destination served are altered to meet shipping and market conditions. This will be specially requisite for shippers of fruits, vegetables, and other perishables.

5. Solution to weather problems. Meterological conditions are seen having a less restrictive effect upon the completion of flights operated by air-cargo carriers, because of their flight flexibility. This weather factor is again of major import in the shipping of perishables. If, at any season, weather conditions prove unfavorable over a specific route, the contract operator can select another route as he desires. This would preclude any necessity for last minute cancellation of shipments due to lack of alternate standard routes. In addition there would be a decided minimizing of the difficulties involved in grounding at points along the way and arranging emergency distribution of the load. What's more, headaches and delays of re-routing air shipments from one standard line to another would likewise be precluded.

6. Minimizing of handling. Present certificated-route cities, particularly in the crop raising states, are often too remote from the growing or producing areas. Only through interchange of equipment could conventional lines avoid the necessity of loading and unloading of through air cargo at junction points. The air-cargo carrier can minimize handling by contracting flights direct from production area to consumption terminal, with avoidance of interchange and rehandling.

And so it becomes increasingly apparent that such special services will be required if the air cargo field is to be fully

At LaGuardia Field, N.Y.C., load of fresh produce flown direct from Florida is transferred to a truck for quick delivery into city. Air Cargo Transport Corp. opened its special air-haul service last year with fleet of three converted Lockheed Lodestars. Author points out that operations of such companies—now conducted on a charter basis —would be broadly facilitated by revision in CAB regulations.

developed. It will, however, be almost impossible to operate a specialized and complete air cargo service today unless some important changes are made in Civil Aeronautics Board regulations governing air transportation.

From a strictly legal point of view, the jurisdiction of the CAB is limited to a regulation of the air carriers transporting persons or property as common carriers, as specified in Section 1 (2) (21) of the Civil Aeronautics Act of 1938. It is, however, theoretically possible to operate an air cargo carrier outside the common carrier category.

What Is a Common Carrier?

Carriers are generally classified as private or as common. Private-carrier operators may devote their activities to conveying their own property solely; or they may, without being engaged in the business of carrying as a public employment, undertake to deliver goods in a particular case for hire or reward. This being the case, the courts have held at times that a common carrier can, under some circumstances, act as a private carrier. However, the term "common carrier" is generally understood to mean one which, as a regular business, transports persons or property from place to place as a service for those who may employ it and pay its charges.

The common carrier in the motor vehicle field most nearly approximates the aviation common carrier. The courts have held that a common carrier by motor: (1) Must be engaged in the business of carrying for others as a public employment and must hold itself out as ready to engage in the transportation of persons or property; (2) must undertake to carry by the methods with which its business is conducted and over its established route; (3) must supply transportation which is for hire; and (4) must, without distinction, undertake to carry all persons within the limits of its capacity and the sphere of its business. The courts have also held in motor cases that an enterprise may be classed as a common carrier even though it does not exclusively, continually, or regularly engage in such carriage.

It has been stated upon many occasions that the test of a common carrier is not whether it is carrying out public employment nor whether it carries to a fixed place, but whether it establishes, either expressly or by course of conduct, that it will, without distinction, serve the public to the limit of its capacity. If the carrier's services are available to all members of the public who may require them, the fact that only a limited number may have the occasion to use the services does not make the carrier a private carrier. What factors are necessary to constitute a carrier as a common carrier is, generally, a matter for the courts to determine. But whether the particular type of transportation offered by an air-cargo carrier makes it a common carrier is a question for the CAB.

The determination of whether an air carrier is, or is not, a common carrier might well prove to be an intricate problem. A similar problem has arisen in construing the Motor Carriers Act of 1935, which provided for three classes of carriers—private, contract, and common. Under this act, a contract carrier is defined as any person who, or agency which, under special and individual contracts or agreements, transports passengers or property in interstate commerce by motor vehicle for compensation. So long as a motor carrier operates under one or two special and individual contracts, it retains the status of a contract carrier for the purpose of regulation. When the number of contracts increases, however, it is difficult for a carrier to retain the status of a contract carrier. Several decisions of the Interstate Commerce Commission make it clear that the guise of a contract carrier cannot be used to perform common carrier operations under the Motor Carrier Act.

It is possible, of course, that the CAB might differ from the Interstate Commerce Commission in interpreting the facts of a specific case. It should be noted, however, that the Civil Aeronautics Act of 1938 contains no reference to contract carriers. Therefore, it would seem that air carriers must have the status of either a private carrier or a common carrier—unless the Board establishes additional classifications of air carriers.

A solution of the problem would be for CAB to establish a classification for air carriers which are engaged solely in the transportation of property (except mail). That is to say, the air-cargo carriers. This classification would be a simple one, but at the same time it is definite in its application to the situation. Of course, as factual information became available from the results of such operations, new classifications might be required. Air cargo carriers would be subject to all other applicable provisions of the Act. This special type of classification would, however, permit a free pioneering of the field.

It appears that the operations of the air-cargo carrier will partly involve the service of a private carrier and partly the service of a common carrier. For example, when such a carrier flies fresh fruits and vegetables from California, the operation may be primarily that of private carrier, when the flights are made under individual contracts with one large shipper or a few small ones. But as the business expands—to provide service for a larger number of shippers—the operation may approach the status of a common carrier.

Certainly there should be no desire to restrict the number of shippers to whom an air-cargo service may be made available—for certainly if a truly public service is to be rendered, such air-cargo facilities should be made available to all shippers who desire to use them. Thus the nature of a "common" carrier would be approached.

With a return haul to California accommodating manufactured products, an air cargo operation, even initially, may be that of a common carrier. The volume of manufactured goods available to the air-cargo carrier can be increased as the service is made available to all of the manufacturers at the eastern and northern terminals.

Such studies as those made by the Edward S. Evans Transportation Research Organization indicate that there is, at present, a substantial volume of manufactured articles which feasibly may be moved by air. These operations would be particularly practical if a carrier is allowed to operate under contract with five or six individual companies. Additional cargo could be secured by increasing the number of shippers. As noted, a general expansion of air cargo services might have the effect of putting such carriers in the common carrier category.

Thus we say that it seems desirable at this time to recognize that the air-cargo carrier might operate as a private, as a contract, or as a common carrier. In any event, actual operations would throw light on the precise classification needs. But at the outset, no restrictive classifications should be imposed. The air-cargo carrier should be left free to develop this field of transport to the fullest.

Accordingly, it is suggested that CAB adopt the following economic regulation:

(a) Classification of Air-Cargo Carriers

There is hereby established, within the meaning of section 416 (a) of the Civil Aeronautics Act of 1938, as amended, a classification of air carriers which engage solely in the transportation of property (except mail) by air, said classification to be designated as "Air-Cargo Carriers".

(b) Exemption of Air-Cargo Carriers

Until the Board shall find, after notice to all Air-Cargo Carriers, that further rules, regulations, or orders are required, Air-Cargo Carriers shall be exempted from the provisions of § 401 of the Civil Aeronautics Act of 1938, as amended, and the regulations of the

Civil Aeronautics Board promulgated under said § 401, except that the exemptions provided by this regulation shall not be applicable to the provisions of subsection (1) of § 401 of the Civil Aeronautics Act of 1938, as amended.

The adoption of this suggestion will have certain benefits which cannot be gained under existing regulations. Among these benefits are:

(1) *Full development of air-cargo potential.* Air cargo service has not yet been offered at really low rates and in a manner favorable to full development of this field.

(2) *Accumulation of valuable factual data.* The dearth of experience in the air-cargo field makes it desirable to obtain information by actual operations—seen as the only way of revealing the best way to serve that market.

(3) *Provision of air cargo service without governmental subsidy.* Since the air-cargo carrier will not be certificated to carry air mail, no cost to the government will be incurred. The air-cargo carrier will sometimes use established airways, but such use cannot be considered as an additional governmental cost.

(4) *Minimum of adverse effect upon present air carriers.* Revenues of present air carriers are chiefly from passengers and mail. In the six years from 1938 to 1943, the revenue from air express never reached as high as 7% of total airline income. Since the air-cargo carrier will not transport mail or passengers, it will not divert any of these revenues from other air carriers. Nor will an air-cargo carrier divert much air express revenues from present carriers. The air-cargo carrier will transport quantity freight—not small express shipments. The air-cargo carrier will attract new business which has not heretofore moved by air, except on a quite limited scale. As far as commodities of a highly perishable nature are concerned, many have never moved, in substantial quantity, by any type of carrier; thus there is offered a new field—one hitherto untapped by the air transport industry.

(5) *A market for surplus aircraft.* Disposal of surplus transport aircraft remains a problem. The inauguration of a comprehensive U. S. air-cargo service will provide a market for such used aircraft. ATC and NATS transports have been used extensively in carrying all types of cargo by air, and it is seen likely that with slight modification these craft can be used to advantage by air-cargo carriers.

(6) *Employment for veterans.* Operations of air-cargo carriers will help to provide jobs for returning air forces servicemen, many of whom desire to continue in aviation work.

Unless the suggestion made here is followed, exempting air-cargo carriers from the provisions of Section 401 of the present Act, we believe it will be practically impossible for such carriers to provide a service which is in the public interest.

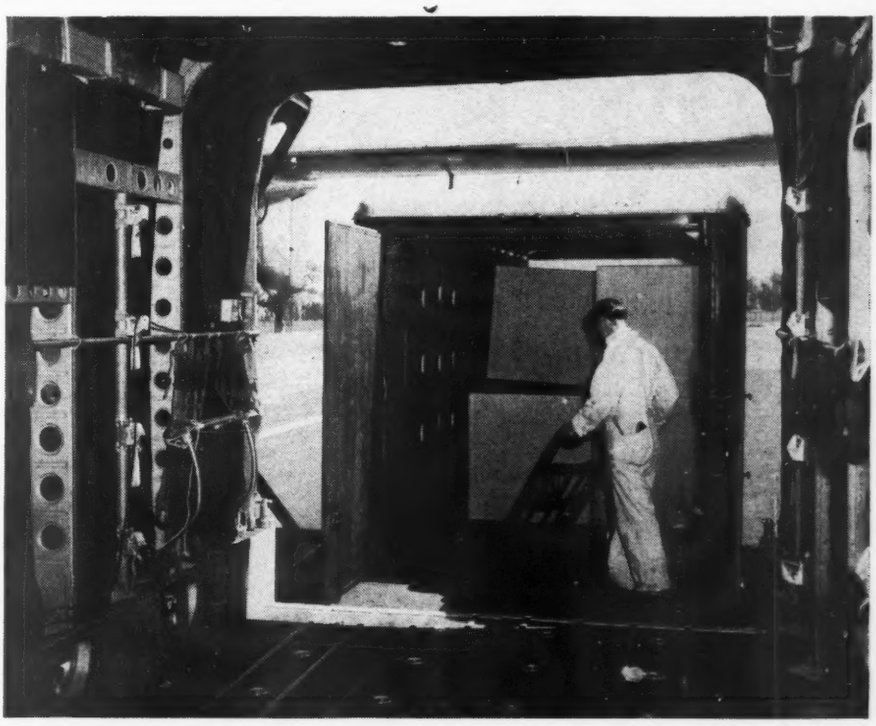
As far as the obtaining of certificates of public convenience and necessity is concerned, there is certainly a dilemma: For one thing, sufficient factual data are not now available to prove the requirements of public convenience and necessity according to the standards heretofore applied by the CAB. Unless these data are made available, it is doubtful that any air-cargo carriers will be in a position to obtain a certificate. The only way in which these data can be supplied is by the actual operation. On the other hand, the air-cargo carriers are faced with the need, under existing regulations, to secure a certificate of public convenience and necessity before operations can be commenced.

The air-cargo carrier probably cannot fully develop its potential market unless it operates, at least in part, as a common carrier. Private or contract carrier operations alone are therefore not the solution to the problem. Under present regulations of the CAB, it is not even possible for an air-cargo service—which, say, seeks return loads following the carriage of perishables—to engage the services of, and operate under contract with, a freight forwarder. In the Universal Air-Freight case, the CAB held that such a forwarder is an air carrier and must obtain a certificate of public convenience and necessity before commencing operations.

It is no answer to this problem to rely upon the general exemption which permits non-scheduled service. In the first place, the present exemption order defines a schedule as the declaration of an operator that he will fly one or more planes between any designated points regularly, or at least with a reasonable degree of regularity. In the air-cargo carrier's operation, the points to be served will change from time to time; but the flights (probably originating in evening hours) will be operated on a fairly regular basis, as the demands of the shippers may require. It is not clear that, in so doing, the air-cargo carrier will be providing non-scheduled service within the meaning of the present exemption order.

In the second place, the present exemption order can be changed without notice or hearing. Such a temporary order is not likely to attract the capital required for air-cargo operations. The exemption order proposed herein cannot be arranged until the CAB, after notice and hearing, finds that a change is in the public interest.

The present exemption order refers specifically to persons as well as property. Accordingly, it is subject to alteration, because of changing conditions in the passenger transportation field—a field which has no relation to the air-cargo sphere.



Newly developed transport craft are seen advancing air cargo operations by affording more capacious and more conveniently designed shipping facilities. Here, bulky cartons are taken, at truck-floor level, into boxcar-like body of Fairchild Packet.

Service Begins At the Factory

By L. B. NELSON, *Manager, Service & Parts Dept., Aeronca Aircraft Corp.*

Importance of meeting and, where possible, anticipating customer needs brought new departmental organization at Aeronca. Here's how it's set up and how it functions.

THE OLD BUSINESS ADAGE that "whatever moves requires service" is finding new importance in the personal aircraft industry where safety and utility are vital sales factors. And as personal flying expands, adequate service, particularly in supplying spare parts, will assume even greater importance.

It was with this fact in mind that Aeronca Aircraft Corp. three years ago made long-range plans for development of its service department. These plans called for new billing and accounting systems, expansion of stockrooms and personnel, and close material control. Indeed, they even called for changing location of the department and changing the name to Service & Parts Dept.

To carry out the program, the department has been organized to handle the various functions under these general headings:

1. Procurement and manufacture of parts,
2. Sale of spare parts, and
3. Related service-and-parts department functions.

Since the prime requisite to the manufacturer—and thus prime factor in getting results for his distributors and dealers—is raw stock material control, this function is handled as a separate section of the production department's material control. Thus it is possible to take advantage of company purchases, with consequent economies which are further enhanced by the fact that combining orders cuts down on the amount of clerical work needed. Requisitions for

Fast, accurate handling of spare parts orders is prime policy of Aeronca's Service & Parts Dept., as means of aiding distributors and dealers. Shown here are special order-layout tables used in making up spare parts shipments to go to distributors. (Aeronca photos)

purchased parts as well as raw materials go through production material control.

Periodically, this raw material control setup is carefully reviewed and, if necessary, revised, so that varying field requirements will not result in either excessive or inadequate inventories.

For manufacturing of parts for noncurrent planes, a separate unit known as the Service Parts Manufacturing Div. has been set up, not only to insure better service to customers, but also to permit the main factory to concentrate on production of current models. So complete is the separation that the parts manufacturing division has its own factory building with its own tools and equipment. However, the operation of the unit is under authority of the factory superintendent, with work orders and production planning being handled by the service and production department's production clerk.

Two parts stockrooms are provided—one for spare parts in the main plant, the other in the parts manufacturing unit. In both cases, perpetual inventory is kept and, except for raw stock, no other control is needed. This perpetual inventory is maintained by a Kardex system, which is revised semi-annually. At each of these times the past trends are carefully studied as a means of projecting probable requirements for the future.

Flexibility of the system has been proved by recent chaotic economic conditions in which the too-familiar words "critical shortage" have kept cropping up. Dispatching, expediting, and follow-up are still just as important as they were during the war, so that a hard and fast rule of the service and parts department calls for immediately advising a customer whether or not prompt shipment can be made. It is simply a case of "doing unto the customer as you would have your supplier do unto you."

For current production aircraft, service needs are scheduled so that, over six months' periods, the production department can maintain a steady supply. In some cases the parts are manufactured in lots and sent to the stockrooms for withdrawal as needed; other parts move "in flow" with complete airplanes. On flow items, schedules are set up on a six-month basis, but the service and parts department can change its requirements from month to month as conditions change in the field.

Obviously, there must be a certain amount of guess work in scheduling current-production aircraft parts but, based on careful analysis of past sales of equivalent parts and careful consideration of basic design changes, it has been possible to come reasonably close to establishing sound, workable inventories.

Cy Bowley, Aeronca spare parts stock manager, and Phil Scherer, assistant service and parts manager, check break-down displays which have been set up to increase speed and accuracy in filling parts orders.

In the second general function—the sale of spare parts—it has been company policy to move parts to ultimate customers only through its regular distributor-dealer channels; the dealers themselves are urged to order only through their distributors.

To assist in proper distribution of parts throughout the territories, what are known as "Suggested Lists" are provided after the semi-annual recapitulations, with correlations set up on a basis of aircraft based in distributor trade areas.

To help assure adequate movement of spare parts, dollar volume figures on sales by distributors are constantly maintained. Sales for each territory are correlated with the number of aircraft based in that territory, giving the value of parts sold per plane. This accounting, it should be emphasized, is by distributor territories. Thus, it is possible to tell at a glance just how each distributor stacks up with all the others. Moreover, necessary action can be taken to make sure that the customers of these distributors get the right kind of service—and that the distributors themselves are making their full share of profits.

Effective the first of this month, Aeronca is inaugurating a quarterly stock check showing minimum parts requirements based on a continuously revised aircraft distribution chart.

This check will also incorporate control for all obsolete or obsolescent items of high cost. Under this system, each distributor will note on his quarterly stock-check list (subject to company approval or, at company suggestion, subject to the distributor's approval) obsolete parts within the dollar value limitation established. These parts will then be entered in the service and parts department control Kardex, and all orders for such parts will be cleared through it. Thus when an order is received the distributor wanting to move the part is notified, and he ships direct to the dis-

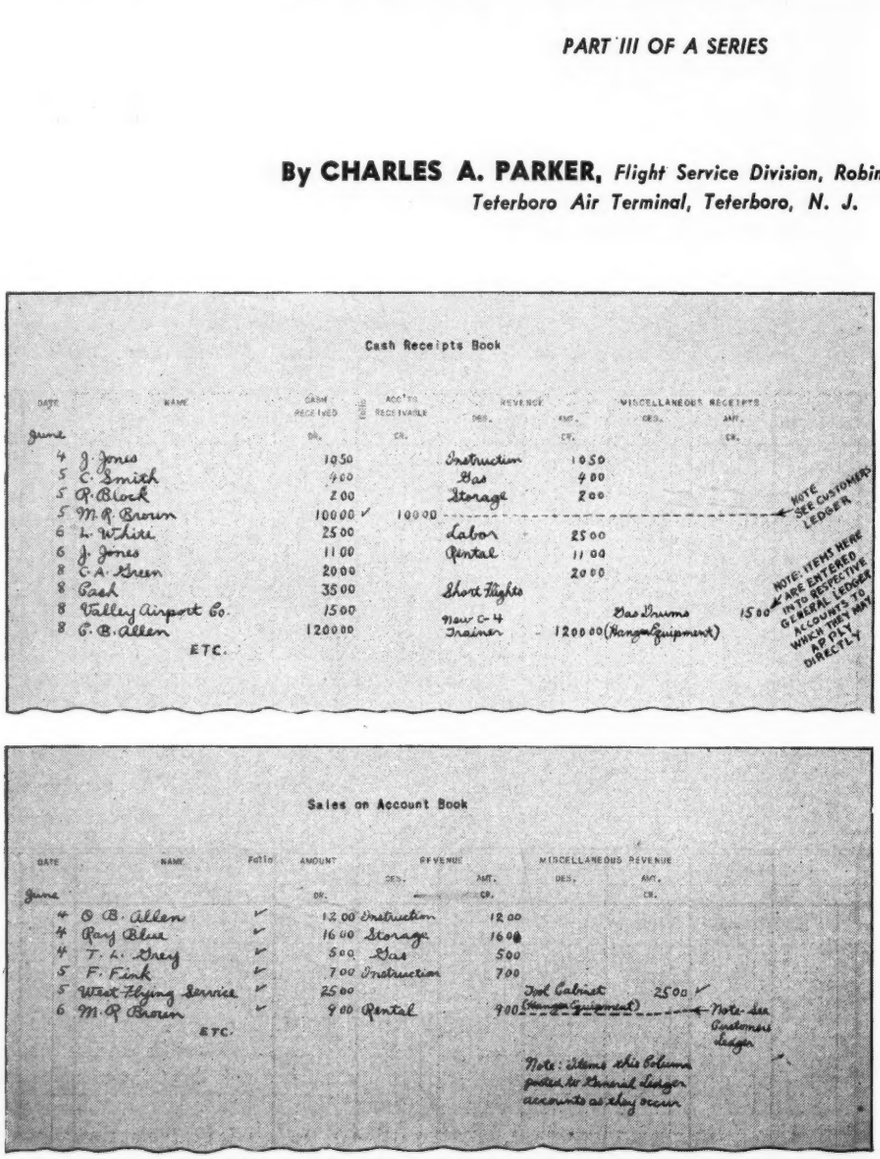
(*Turn to page* 153)

Prosperity—or bankruptcy? Whichever way a business may be heading, income-minus-outgo gives the final verdict, with the relative quantities of each proving the deciding factors. Accordingly, Author Parker details this proven airport accounting system which, at all times, will enable the operator to—

KNOW WHERE THOSE DOLLARS ARE

PART III OF A SERIES

By **CHARLES A. PARKER,** *Flight Service Division, Robinson Aviation, Inc.*
Teterboro Air Terminal, Teterboro, N. J.



Cash Receipts Book

DATE	NAME	CASH RECEIVED DR.	ACCTS RECEIVABLE CR.	REVENUE DES.	REVENUE AMT. CR.	MISCELLANEOUS RECEIPTS DES.	MISCELLANEOUS RECEIPTS AMT. CR.
June							
4	J. Jones	10 50		Instruction	10 50		
5	C. Smith	4 00		Gas	4 00		
5	P. Block	2 00		Storage	2 00		
5	M. R. Brown	100 00 ✓	100 00				
6	L. White	25 00		Labor	25 00		
6	J. Jones	11 00		Rental	11 00		
8	C. A. Green	20 00			20 00		
8	Cash	35 00		Short Flights			
8	Valley Airport Co.	15 00				Gas Drums	15 00
8	C. B. Allen	1200 00		New C-4 Trainer	1200 00 (Hangar Equipment)		
	ETC.						

NOTE SEE CUSTOMERS LEDGER

NOTE: ITEMS HERE ARE ENTERED INTO RESPECTIVE GENERAL LEDGER ACCOUNTS TO WHICH THEY APPLY DIRECTLY

Sales on Account Book

DATE	NAME	Folio	AMOUNT DR.	REVENUE DES.	REVENUE AMT. CR.	MISCELLANEOUS REVENUE DES.	MISCELLANEOUS REVENUE AMT. CR.
June							
4	C. B. Allen	✓	12 00	Instruction	12 00		
4	Ray Blue	✓	16 00	Storage	16 00		
4	T. L. Grey	✓	5 00	Gas	5 00		
5	F. Fink	✓	7 00	Instruction	7 00		
5	West Flying Service	✓	25 00			Inst Cabinet (Hangar Equipment)	25 00 ✓
6	M. R. Brown	✓	9 00	Rental	9 00		
	ETC.						

Note: See Customers Ledger

Note: Items this Column posted to General Ledger accounts as they occur

FIG. 1 **Cash Receipts and Sales On Account**

ACCOUNTING may not comprise very attractive subject matter to the average field operator. But if he expects to have his business well in hand, a knowledge of prime figure-factors, together with some fundamental ability to handle them, is pertinent. And no two ways about it.

Accordingly, we present here a simple, yet practical, system for the operator who is carrying on student instruction, charter, sightseeing and rental flying, gas, oil, storage, and aircraft sales and service.

Books required are eight in number: General Journal, Cash Receipt Book, Sales on Account Book, Cash Disbursements Book, Purchases on Account Book, also General Ledger, Customers Ledger, and Creditors Ledger.

In these books all transactions are entered from flight sheets, gas or line service slips, job orders, parts slips, etc.

Other accounting items include: Monthly trial balances, monthly analysis sheets of income and expenses, and yearly or semi-yearly statements of assets and liabilities, and profit and loss.

The General Ledger will be little utilized after the initial entries are made when opening up the business. It will carry miscellaneous transactions from time to time—those not provided for in the current books. And at the end of

each year, certain terminating entries and adjustments will be made prior to compiling the final statements of profit and loss, and assets and liabilities.

Cash Receipts Book and the Sales on Account Book are illustrated in Fig. 1, with some typical entries. In the case of money received "on account", entry is made from the Cash Book into Customers Ledger accounts. Sales not paid for in cash are carried through to this latter ledger, which is illustrated (Fig. 2) with entries from the two aforementioned books. Cash received daily will be deposited directly into a bank account. Under no circumstances can this money be spent if a balanced system is to be maintained. Necessary expenditures are to be made through the checking account or from petty cash box.

Totals of the two income books go, at the end of each month, into the General Ledger accounts. Totals of the General Ledger accounts are taken at the end of each month as the items for the trial balance.

Trial balance (Fig. 3) is a summary which shows that the entries have been correctly made and that the accounting system is in balance.

Weather Vane for Business

One of the most useful offshoots of the system are monthly analysis sheets on which entries of the two income books can be drawn off, grouped by items of business at the end of each month—a valuable working aid and a weather vane for the enterprise. The operator can set quotas to serve as goals for an expanding business. An analysis sheet for the income side of the business is shown in Fig. 4.

On the other side—that of the outflow of money—are the Cash Disbursements Book and the Purchases on Account Book (shown in Fig. 5). Entries of transactions not involving cash are made from these books into the Creditors Ledger.

Outgo is calculated from the check book and incoming bills. These items are broken down into classifications, such as: The party from whom purchases have been made, amounts owed individually, totals owed, and the individual expense items and their totals. Expense or outgo includes such operational items as: Light, heat, water, payroll, telephone, telegraph, office expense, etc.

FIG. 2 Customers and Creditors Ledgers

Customers Ledger

Sheet No. _____ Account No. _____
Terms
Rating NAME M. Brown
Credit Limit ADDRESS 30 Main St. Northboro Tenn.

DATE	ITEMS	FOLIO	✓	DEBITS	DATE	ITEMS	FOLIO	✓	CREDITS
June 1		SB		1000	June 5		CB		10000
6		"		900					
15		"		500					
20		"		1500					
21		"		400					
29		"		1000					
				5300		Bal. June 30 - 4700			10000

Creditors Ledger

Sheet No. _____ Account No. _____
Terms
Rating NAME The Texas Co.
Credit Limit ADDRESS Northboro Tenn.

DATE	ITEMS	FOLIO	✓	DEBITS	DATE	ITEMS	FOLIO	✓	CREDITS
June 3		CBB		7000	June 1		PB		10500
10		"		5000					

FIG. 3 Sample Monthly Trial Balance

	Dr.	Cr.
Cash	535.50	
Petty cash	10.00	
Accounts receivable	707.50	
Inventory (parts & supplies)	362.00	
Operating planes & engines	4,520.00	
Reserve for depreciation of planes & engines		1,250.00
Planes for resale	1,500.00	
Hangar tools & equipment	215.00	
Office furniture & equipment	110.00	
Reserve for depreciation of hangar tools & equipment		45.00
Reserve for depreciation of office furniture & equipment		28.00
Service deposits	50.00	
Manufacturers deposits	500.00	
Goodwill	1,100.00	
Accounts payable		450.50
Notes payable		250.00
Current account (proprietor)	175.00	
Capital stock		6,000.00
Surplus		500.00
Sales & revenue		10,691.50
Misc. income		225.00
Purchases of materials, parts & supplies	3,550.75	
Operating expenses	3,464.25	
Salary (proprietor)	2,600.00	
Interest paid	42.00	
Total	19,440.00	19,440.00

Expenses incurred for items purchased to be turned into direct income include: Gas and oil, parts and supplies, aircraft purchased for resale or use, etc. These are posted directly in their respective general ledger accounts. Items such as

FIG. 4

Analysis of Sales

NORTHERN AIRWAYS INC.
Analysis of Sales - 1940

DATE	DATE	FROM	TOTAL AMOUNT	CHARTER	INSTRUCTION AND RENTAL	SHORT FLIGHTS	STORAGE	GAS	OIL	LABOR	PARTS AND SUPPLIES	COMMISSIONS ON SALE OF EQUIPMENT	AIRCRAFT SALES (3)	MISC.
	June	CRB (1)	2556 35	350 00	410 50	115 00	80 00	165 25	35 25	112 35	73 00	175 00	1090 00	10 00
		SB (2)	616 25	-	320 25	-	40 00	61 00	-	133 00	62 00		-	-
		TOTAL SALES	3172 60	350 00	730 75	115 00	120 00	166 25	35 25	245 35	135 00	175 00	1090 00	10 00
	July	CRB	3024 50	280 00	515 00	132 00	95 00	162 00	42 00	131 50	72 00	50 00	1525 00	-
		SB	809 00	-	390 00	-	80 00	98 00	12 00	142 00	87 00	-	-	-
		TOTAL SALES	3833 50	280 00	905 00	132 00	175 00	260 00	54 00	273 50	179 00	50 00	1525 00	-
	ETC.													

Footnotes to analysis sheet above: [1]"CRB" refers to Cash Receipts book; [2]"SB" means Sales Book; [3]Aircraft Sales may be broken down, if desired, into New Aircraft Sales and Used Aircraft Sales.

rent would be shown in the General Journal as a monthly charge against the business. Secondary or follow-through entries are made from the General Journal, much the same as from the cash and other books of account. After all, the Journal is a master book, with cash receipts, cash disbursements, and the like, comprising its subdivisions. In a small enterprise having only a few transactions of a seldom-varying nature, a single General Journal could comprise the initial book of entry. Many variations in accounting are possible, but the outline shown here—used in a prewar operating company—is notable for its practical foundation.

Checks are numbered and must be accounted for. Those written are entered into the Cash Disbursements Book, with notations as to the party to whom the check is written and whether it was for operating expense or materials. A check to pay some account outstanding, would be listed under accounts payable and would be transferred to the Creditors Ledger.

The two books of expense are handled similarly to the "income" books. Monthly totals are transferred to General Ledger. Totals are then taken, and the final balance of each makes up the data in the trial balance. A suitable analysis sheet will allow the proprietor to keep a running check of expenses, the same as with income.

Various accounts in the General Ledger and trial balance are:

Cash. All cash received and put out goes into this account, which must check with the bank statements and the check book balance.

Accounts receivable. Totals of monthly individual accounts in Customers Ledger will equal the balance in this account, which shows the difference between cash paid by customers and sales made on account, and which also shows the total outstanding amount due the operator.

Notes receivable.

Inventory of Parts and Supplies.

Operating planes and engines.

Planes for resale.

Hangar tools and equipment. In this account, values of respective items are listed.

Reserve for depreciation of operating equipment. This is to cover lessening value of equipment. Methods and allowances are defined by Federal tax agencies. Interest will be entered in this account at the end of each year, as the books are closed.

Reserve for hangar tools and equipment and reserve for office equipment.

Service deposits. This is money deposited with utility or other service companies.

Manufacturers deposits. These are deposits with aircraft factories or distributors.

Goodwill. This, of course, is an intangible item. For example, a pilot-operator of long standing might have much beneficial influence with those who leased the airport or with the clientele, and since these are obviously factors of worth it is feasible to place value upon them under the heading of goodwill.

Accounts payable. These are totals of the columns carrying this heading in the Cash Disbursements Book and also in the Purchases on Account Book. Difference between the two gives the total of the accounts payable and equals all the balances of individual accounts in the Creditors Ledger.

Notes payable. These are notes that the company owes, together with payments made on same from Cash Disbursements Book, miscellaneous column.

Cash Disbursements and Purchases On Account

Cash Disbursements Book

DATE	TO WHOM PAID	CHECK NO.	NET AMOUNT CR.	ACCOUNTS PAYABLE PAID DR.	CASH PURCHASES MATERIALS AND SUPPLIES DES.	CASH PURCHASES MATERIALS AND SUPPLIES AMT. DR.	OPERATING EXPENSES DES.	OPERATING EXPENSES AMT. DR.	MISCELLANEOUS PAYMENTS DES.	MISCELLANEOUS PAYMENTS AMT. DR.	
June											
3	The Texas Co.	132	90 00 ✓	90 00							NOTE: SEE CREDITORS LEDGER
4	Linn Hardware Co.	133	15 00				Office Expense	15 00			
5	Aero Supply Inc.	134	55 00 ✓	55 00							
5	F. L. Parks	135	20 00				Legal Fee	20 00			
6	Supreme Oil	136	24 00		Oil	24 00					
6	Eastern Trust Co.	137	30 00						Interest	30 00 ✓	
6	Airport Service Inc.	138	22 50		Parts	22 50					
6	Void	139	-								
	A. A. Jackson	140	10 00						Hangar Tools	10 00 ✓	

Note: The above items are posted directly into the general ledger accounts as they occur

Purchases on Account Book

DATE	PURCHASED FROM	POSTED	ACCOUNTS PAYABLE PURCHASES CR.	RETURNS DR.	MATERIALS AND SUPPLIES DES.	MATERIALS AND SUPPLIES AMT. DR.	OPERATING EXPENSES DES.	OPERATING EXPENSES AMT. DR.	MISCELLANEOUS PURCHASES DES.	MISCELLANEOUS PURCHASES AMT. DR.	
June											
1	The Texas Co.	✓	105 00		Gas	105 00					NOTE: SEE CREDITORS LEDGER
2	Aero Supply Inc.	✓	25 50						Hangar Tools	15 00 ✓	
			7 00		Parts	18 50					
3	J. L. Smith	✓	22 00				Printing	7 50			
5	Aero Supply Inc.	✓			Parts	22 50					
5	Jones Bros	✓	19 00						Office Furniture	19 00 ✓	

Note: The above items are posted directly into the General Ledger Accounts as they occur.

FIG. 5

Capitol stock account. This shows the value of outstanding corporation stock.

Surplus. When the books are adjusted at the end of each year, transfer is made to this account from a temporary profit and loss account. Surplus accounts appear only in corporation books. In an individual enterprise, an account carrying the owner's name would take the place of the surplus account.

Sales and revenue. These comprise monthly totals of all sales.

Miscellaneous income. This covers items not dealt with elsewhere.

Purchase of parts and supplies.

Operating expenses.

Officers salaries. This gives a breakdown of salaries for tax reports, when the setup is a corporation.

Drawing account. This covers withdrawals above salary made by the owner.

Interest paid.

When all entries have been made, at the end of the month, in these ledger accounts, each is totaled individually and then set up as the trial balance.

It is this detailed information—flowing into the system daily and summarized monthly—that enables a year-end trial balance to be taken. With the assistance of a CPA, the trial balance will serve for making certain final entries to close the books for the year, including necessary adjustments to keep taxes at a minimum. It will then be possible to draw off a final statement of profit and loss (Fig. 6) and assets and liabilities (Fig. 7). And thereafter the operator may complete his tax forms for filing.

FIG. 6 **Sample Year-End Statement of Profit and Loss**

Gross sales		$22,850.00	
Less allowances and returns		325.00	
		$22,525.00	
Inventory (beginning of year)	$1,850.00		
Purchases (net)	8,225.00		
Total	$9,075.00		
Less inventory (year end)	1,120.00		
Cost of sales		$7,955.00	
Gross profit on sales			$14,895.00
Selling expenses:			
Commissions paid	$1,300.00		
Travel expense	825.00		
Advertising	500.00		
	$2,525.00		
Administrative expense:			
Officers salaries	4,000.00		
Office expenses	630.00		
	$4,630.00		
General expenses:			
Insurance	500.00		
Rent	1,000.00		
Taxes	250.00		
Payroll	3,500.00		
Operating expenses	1,750.00		
	$7,000.00		
Total expenses			$14,155.00
Net profit on sales			$740.00
Misc. gross income (add)			720.00
Gross income			$1,460.00
Deductions (interest paid)			30.00
Net income—profit & loss			$1,430.00

FIG. 7 **Sample Statement of Assets and Liabilities**

Current assets:			
Cash		$550.00	
Accounts receivable	$925.00		
Notes receivable	500.00		
	$1,425.00		
Less provision for bad debts	150.00		
		1,275.00	
Balance		$1,825.00	
Inventories (parts & supplies)		430.00	
Proprietors drawing account		200.00	
Total current assets			$2,455.00
Capital assets:			
Hangar tools & equipment		$210.00	
Office furniture		110.00	
Operating aircraft		4,520.00	
Aircraft for resale		1,500.00	
		$6,340.00	
Less reserves for depreciation		1,320.00	
			5,020.00
Goodwill			2,000.00
Total assets			$9,475.00

Current liabilities:			
Accounts payable		$750.00	
Notes payable		225.00	
Accrued wages		100.00	
Crash reserves (not deductable from assets)		400.00	
Total current liabilities			$1,475.00
Fixed liabilities (none):			
Total liabilities			1,475.00
Net worth:			
Capital stock (authorized)		$8,000.00	
Less capital stock (unissued)		2,000.00	
		$6,000.00	
Surplus (or deficit)		2,000.00	
			$8,000.00
Total liabilities			$9,475.00

All-In-One Mapigator Simplifies That Flight Plot

Here's a handy, easy-to-operate avigational aid designed for the personal pilot who aims to hit his destinations on the nose with professional skill. This instrument features direct use of standard aero charts in conjunction with built-in plotting devices.

A NEW AND VERY COMPLETE avigational device—the mapigator—should be of great interest to personal pilots. It has been developed by a former military avigator who is himself a private flyer.

Outstanding features of the Mapigator are its compactness, simplicity of operation, and the fact that it combines the function of many other instruments, such as plotters, dividers, protractors, parallel rules, wind-vector computers, slide rules, and the like. It is used in direct conjunction with map reading, holding the map neatly, keeping it constantly handy, and preventing it from getting wet, smudged, marked-up, or blown about the cockpit.

Briefly, the Mapigator is a lightweight device about 14 x 16 x $\frac{7}{8}$ in. in size. It holds the map between a transparent unit and a white baseboard, with these being connected by thumbscrews. The transparent unit is composed of several parts: A coversheet (almost the same size as the baseboard), marked with a compass rose and surfaced for pencil writing; a grid disk, half of which is marked with parallel lines and concentric circles, rotatable at bottom and left side recesses in the baseboard; an ad-

(*Turn to page* 151)

Unique design of Mapigator permits "on-the-map" plotting, since all markings are made on transparent coversheet which may be easily cleaned. Here grid disk has been turned to give unobstructed view of sectional map. Compactness of device is noteworthy, and utility is further increased by firm baseboard which makes Mapigator easy to use while flying. Positions of thumbscrews may be changed to compensate for proper placement of map. Features of device are noted as follows: (A) Baseboard, (B) edge of coversheet, (C) pencil holder, (D) grid disk, (E) compass rose, (F) flight log, (G) computer, (H) wind arrow, (I) recess for rotating grid disk, (J) distance scale, (K) thumbscrew, and (L) bulldog clip. Arrangements are now being made for production of device.

TAGGING THE BASES

Will Veterans Take Over?

Writing in the *Monthly News Letter* of the Washington State Aviation Assn., A. L. Baxter, retiring president, says "We have had a little taste in the past few months of what is going to happen in the future in the matter of new operations starting up. Personally, I am of the opinion that a lot of us old-timers are going to be taught a lot of new tricks by the new-timers."

The above opinion is expressed by an experienced operator who known how to make money at this business. And the fact that he is willing to go on record shows that he believes that there is plenty of room for improvement in airport operations. New men coming from the armed forces have received their training from men who had nothing to sell—but plenty to tell. Result of his training is that the flyer returning to civil life will tend to adhere to the systematic methods he learned in uniform, which means that he will generally be more efficient. The constant inspections and rigid rules will carry over, hence the vet will favor having the airport cleaner and more orderly, and he will give the visiting public a far better impression than could be given by a far too large percentage of the fields which have been in operation for years.

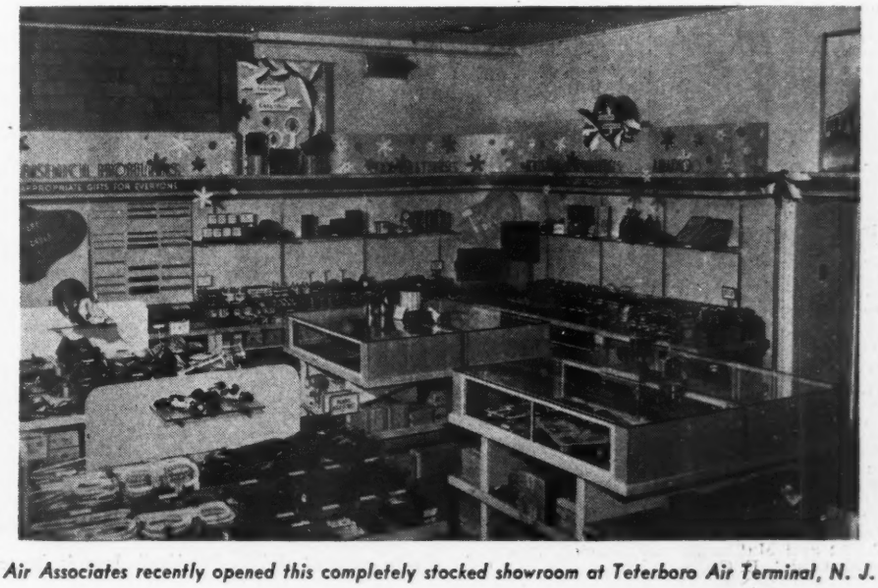
In this connection, NAA now is formulating a plan for airport checking and reporting. By this plan, airports will be invited to apply for awards, made on the basis of safety, cleanliness, efficiency, etc., and local newspapers will be notified, not only that the airport has been invited to participate, but also what the results of the inspections are.

Here the effect of the discipline of the Armed Forces will give the ex-serviceman a strong lead over the operator who has let his airport run down. The well-run airport will never have much to fear from the advent of newer fields, but the day of the sloppy airport is nearly over.

First Region—Aeronautical Trading Co., Jamaica, N. Y., is Johnson Rocket distributor for N. Y. and N. J. . . . Aviation Country Club has been opened at Roland Malheux's Airport at West Minot, Me. Swimming pool, restaurant, lounge, and overnight cabins provide accommodations for tourists, who can hire cars for local tours. Malheux—an aerobatic champion—is representing Piper, Republic, Globe, Scott accessories, and Firestone, as well as handling a line of T-hangars. . . . Pace-Patterson Flying Service, Aeronca dealer, is now operating Painted Post Municipal Airport, N. Y., where a new restaurant has been opened. . . . Westfield Airport, N. J., reports that recently installed field drainage permitted continuous flying during wettest weather. On Washington's Birthday nine ski-equipped planes, each with a passenger, flew to Rocco's Hotel near Lake Susquehanna Airport, staying all night and returning after breakfast. . . . Rickliffe M. Decker has started flight instruction and flying service at Hadley Airport, South Plainfield, N. J. . . . Joseph Alta and Perry Fuhr are now operating Rockaway Airport, N. Y., employing only ex-servicemen. Firm sells Ercoupe and Piper planes and Shell fuel. Flight school now has 100 students and uses 4 Pipers, 1 Ercoupe, a Bellanca Crusair, and a Taylorcraft. Also at field is instrument school run by Al Bevelaque and Eugene Yates, who have 3 PT-23's. . . . W. M. "Wiley" Post, Jr., of Allentown-Bethlehem Airport, is selling Ercoupes in H. Leh & Co's Allentown department store, also keeps a demonstrator at airport. . . . Jumping Brook Aviation Corp. has been organized at Asbury Park, N. J., by C. Murphy, F. Tannenbaum, and G. R. Shindler. . . . Columbia Aircraft Services, (Bloomsburg Municipal Airport, Pa.) is new name of former Aircraft Services Consolidated. C. J. Leutholt, manager, operates advanced flying school, while Harris L. Woods handles service and overhaul. . . . Bob Halpin and Ben Shiffrin have formed Bethany Airways (Conn.) taking over business of Reynold Flying Service at Bethany. Halpin was in crew of first Boeing B-17 to bomb Berlin, and Shiffrin was C.O. of 1st Arctic Search & Rescue Squadron, serving under Bernt Balchen in Greenland for 1½ yr. . . . Virginia Beach Airport and Seaplane Base has been opened on Linkhorn Bay, Princess Anne Co., Va., on property of Cavalier Yacht & County Club.

Second Region—Alabama Aviation Commissioner gives following new listings: Landing strip at Abbeville, owned by J. C. Culpepper; Brewton New Municipal Airport; George A. Fehler Airport, Cullman; Henderson Flying Service Field, Flomaton; and new field owned by Allen and Canter at Florence, moreover, Old Oak Airport, Foley, is being reopened by Luther M. Arant; N. S. Davenport is completing a private field at Ft. Payne with 60 x 60 steel hangar, and will operate as Davenport Flying Service; Goda, Inc., is starting a seaplane base on Tennessee River at Guntersville; John Lakeman is opening a field at Haleyville, with 40 x 60 hangar; J. P. McKee has new field at Jackson; Skyhaven Airpark at Jasper has been opened by N. W. Appling, who has erected 6 T-hangars; Myron Milford is constructing a small field at LaFayette; Wilson & Sullivan have an airport of that name at Montgomery; Max Moody is building a landing strip 1,800 x 300 at Oneonta; at Phenix, J. D. Stillwell is erecting a 40 x 50 hangar on his new field; Henry Van Kesteren is operating new Dallas Field at Selma; M. R. Carl, of Bama Flying Service is operating Foster Field at Tuscaloosa; at Tuscumbia, Neill Flying Service's new Tri-Cities Field, with runways 2,400 x 300 and 1,800 x 300, has new concrete block hangar 50 x 80. . . . Airport operators of Alabama met in Montgomery on Mar. 12 to form state organization. . . . Columbus, Ga., **Enquirer** reports that 3,000 people turned out at airport for glider demonstration by Julius Allen. . . . Seneca Aeronautical Corp., Bowman Field, Louisville, Ky., has been acquired by J. P. Starks, R. Wade, and P. Brown, who will continue business.

Third Region—Flying Farmers Club has been organized by **Prairie Farmer**, 1230 W. Washington Blvd., Chicago (7). Membership covers Ill., Ind., Mich., and Wis. Near Perrysville, Ind., 58 farmer members are using one flight strip. . . . Glenview Naval Air Station is being kept open for use of former Navy pilots now on reserve. . . . Mesaba Aviation, Aeronca, Continental engine and Edo agent, at Coleraine, Minn., is operating both land and seaplane service. . . . Cyril Lebert Airport, Lebanon, Ill., sells Ercoupe and Stinsons, also operates parachute loft. Airport, opened in July '45, now has Packard car for visitor's use. Situated on US-50 and Ill.-43 highways, airport restaurant reports good business from both land and air travelers. Owners are H. W. Lebert and W. J. Pfeffer. . . . Southern Ohio Aviation Co. has leased two hangars at Dayton Airport, Vandalia, Ohio. . . . Northwestern Aeronautical Corp. Holman Field, St. Paul, Minn, is Cessna distributor for that state and is interested in distributorships . . . Ohio University (Athens, Ohio), first in state to give flight instruction, is also offering flight instructor's course. University airport has 3 hangars, Link trainer, and 15 planes. . . . Akron Airport, Ohio, reports that B. F. Goodrich Co's new Beechcraft will be based at that field. Pilots are Fred K. Dick and Louis A. Musgrove. . . . Robert E. Huggins of Waupaca Airport, Wisc., reports that he has soloed three students recently with less than 4 hr. each dual instruction. Huggins, a pilot with 26 yr. flying experience, is giving flight instruction in connection with local high school. . . . Employees of John Meck radio factory at Plymouth, Ind., have formed a flying club with membership of 25. . . . Chicago Park Board now permits seaplane landings at 8th St. and Outer Drive, near Aquarium, within 5 min. from Loop. . . . For information of local pilots, Chicago **Sun** prints daily weather map. . . . Night flying lessons are being given at Rubinkam Airport, Chicago, by Instructor Ray Starzyk. . . . Lester Jolly of Grand Forks, N. D., and T. A. Evanson, Editor of Grand Forks **Herald**, delivered airmail and papers to eight nearby towns after a blizzard had isolated that section of state and tied up railroads. With temperature at 20 below zero, plane—a Piper Cub—flew 320 mi. in 5½ hr. Later same plane and pilot surveyed power lines disrupted by storm.



Air Associates recently opened this completely stocked showroom at Teterboro Air Terminal, N. J.

Fourth Region—Gene McGill, National President of Flying Farmers, is now pres. of Okla. Aviation Assn. Keith Kahle of Central Airlines of Okla. is Exec-Sec. Carlos Webb is v.-p. . . . Ada Flying Service, Ada, Okla., is now Piper and Continental agent. . . . N. M. Airmen's Assn. elected Clark Carr, of Cutter-Carr Flying Service, Albuquerque, as pres; Frank Hines of Hobbs is v.-p., and Harry Vorenburg of Wagon Mound is sec.-treas. Aim of organization is to start fields at points of interest to tourists and at all towns not now possessing landing facilities.

Fifth Region—Mountain States Aviation of Denver, operated by Harry B. Combs and Lou Hayden, is Stinson distributor for that state. . . . Stephens College, Columbia, Mo., first women's college to teach aviation, now has 150 flight students and over 800 taking aviation courses. School now has 28 planes and 2 Link trainers. . . . Charles "Chuck" Harris, Aeronca agent at Heart of the Ozarks, Mo., has built an airport in a 76-acre pasture and is engaged in flight training and crop dusting. . . . Harold J. Baker, Black River Flying Service, Port Huron, Mich., is building a "sky-camp" with hangar and overnight quarters for flyers.

Sixth Region—Oakland Municipal Airport has fixed following landing charges for planes under 2,500 lb.: 75c. each for first 2 landings per month, 50c. each for next 3, 20c. for 25, 10c. for 60, and 5c. for over 90 landings per month. . . . Alamo Airport, Las Vegas, Nev., now has a skyway cafe, featuring a second-floor lounge entirely glass enclosed giving view of airport. Cadillac "16" is provided for service to town. Carl Crawford, flight mgr., has been flying since '26, and "Dick" Knox started in '22. George Crockett is general mgr. . . . Engel Airport, Escondido, Cal., has started a subdivision program of about 100 houses beside field on opposite side to flight pattern. . . . Western Continental Airlines is flying a Grumman Widgeon and 2 Cessnas from Grand Central Airport, Glendale, Cal. . . . San Diego Co. (Cal.) Airport Owners Assn. has started a reckless-flyers "blacklist" which will be posted at all member airports, and culprits will be excluded. . . . Hayward, Cal., has opened a 700-acre airport with two 5,000-ft. runways. C. E. Gibson, ex-PAA pilot, is airport manager. . . . R. A. and W. L. Cranford have recently opened Cranford Airport at Artesia, Cal. . . . "The Pink Sheet", 704 S. Spring, Los Angeles, Cal.—airport buying and selling guide—lists the following new airports on Pacific Coast: Blaine Central Airport, Blaine, Wash.; Gridley Airport, Gridley, Cal.; Sunnyside Field, Sunnyside, Wash.; Green Acres Airport, Molalla, Ore.; Henne Aeronautical College Airport, Kennewick, Wash.; Tacoma (Wash.) Air Park; Pacific Airmotive Airport, San Jose, Cal.; Borderland Airport, San Ysidro, Cal., and Puente (Cal.) Skyranch. . . . Douglas Robinson, of Gilpin Airport, Tucson, Ariz., is now Stinson distributor. . . . Whiteman Air Park, San Fernando, Cal., is Cessna distributor for Southern Cal. Andy Devine and Dick Probert are conducting flight school at airport. . . . Wes Stetson, Taylorcraft and Edo agent, is conducting what is termed highest seaplane base in world at Lake Tahoe, Cal. Elevation is 6,200 ft.

Seventh Region—Richmond Flying Club, Ida., recently volunteered to deliver mail to communities isolated by blizzards. . . . A. A. Bennett has sold Pocatello Flying Service, Ida., to Charles Bolton and David Horn, ex-ATC pilots formerly of Jefferson City, Mo. Firm will continue Piper and Globe Swift agencies. . . . Salem, Ore., set following fees for McNary Field use: Commercial operators, $100 yearly; private owners or club members, $1; hangar rental 40c. per foot wingspan per month or 5c. per foot per night; office rental 5c. per sq. ft. per year, without light or heat. . . . New officers of Washington State Aviation Assn. are: G. R. Cook, Seattle, Pres.; R. Sugg, Vancouver, v.-p.; and D. C. Willard, Marysville, sec-treas. . . . Ben Smith of Smith Flying Service, Kent, Wash., has formed Western Washington Dealers Assn.

Canada—Sid McDonald of Edmonton, Alta., who has formed McDonald Aviation Co., expects to ferry Seabees and Swifts for which firm has distribution contracts for Northwest. Returning RCAF men will be employed exclusively. . . . Air Transport Board licensed following non-scheduled operators recently: Maritime Central Airways, Charlottetown, P. E. I.; Grest Motors Flying Service, Humboldt, Sask.; Service d'Aviation Charlevoix-Saguenay, Bergeronnes, P. Q.; and Malibu Seaero Service, Princess Louisa Inlet, B. C.

AS THE OPERATORS SEE IT

Maybe you've run into a sales and service snag, face some overhaul hurdle, are grappling with a flight teaching tangle, or seek guidance in the maze of maintenance. Whatever the perplexity, it's "fair shooting" here in our operators' corner. Answers, and criticisms of answers, will be paid for at AVIATION's usual rates. Welcome, too, will be photos or sketches which "point up" the problems.

QUESTION 1.—*Will you outline a really proficient method for preserving fabric on aircraft?—F.E.P.*

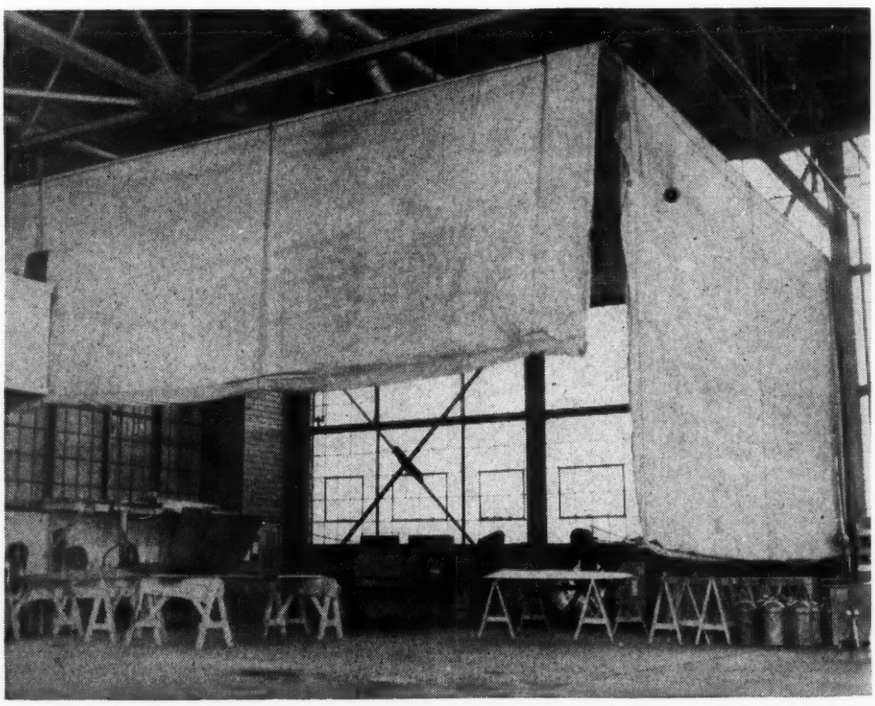
Answer: "With regard to fabric work on our Stinson aircraft, we employ Berry Brothers dope, using a nine-coat system on our re-covering. This consists of two coats of clear dope brushed on the raw fabric, tape being applied with the second brush coat. The fabric is then scuff-sanded lightly to remove threads that have been raised by brush coats.

"Two additional cross coats of clear dope are then sprayed on the surfaces. Clear dope is then sanded smooth. Next two cross coats are silver pigment, applied and sanded. Next three cross coats are color—last coat being wet-sanded and rubbed with a rubbing compound.

"We have found this is the best method for our type operation, from a standpoint of durability and weight. We get 4,500 flying hours on each re-covering—approximately three years service if the airplane is used regularly. However, some fabric jobs have operated seven or eight years without re-covering. Insofar as maintenance of this Flightex Grade A fabric is concerned, the ships are cleaned approximately every two weeks with Auto-Groom Cleaner."—*E. D. Musser, Supervisor of Maintenance, All American Aviation, Allegheny County Airport, Pittsburgh, Pa.*

Answers are Invited To—

Question 2.—Do you make a landing charge when a visiting pilot uses field facilities for a few hours but does not buy fuel or service? What are your reasons for doing or not doing this? Do you find that this landing charge is expected by visitors?—R.K.



Dope room at AAA's Pittsburgh Base is formed by hanging heavy curtains from hangar roof.

Investment Trusts See Worthy Future In Aviation Securities

By RAYMOND L. HOADLEY, *Financial Editor, "Aviation"*

Analysis of portfolios of 15 leading investing companies shows good-sized holdings, despite some 1945 profit-taking sales, with airlines favored over manufacturers.

YES, THE INVESTMENT TRUSTS must feel there is promise for investments in aviation stocks—for 15 of Wall Street's leading investment companies hold thousands of shares of aviation stocks, aggregating some $28,250,000 in market value at the end of 1945.

These investment concerns, as a rule, are pretty choosy where they place their stockholder's funds. Rarely do they stray from a well beaten path in their investment selections. They favor mature industries with long records of financial stability, continuous dividend payments, and maintained earning power.

When the end of the war came, everyone wondered what policies the investment companies would follow with respect to their large wartime aviation holdings. Would they take their profits and switch to stocks with less of a reconversion problem? That was a prime question.

The annual reports of these companies give the answer. There was no wholesale unloading of aviation stocks after V-J Day, though there was some selling, particularly in the aircraft stocks. But most of the investing companies apparently agreed with Pres. Frederick Robinson of National Aviation Corp., that "liquidation of war business in itself does not necessarily represent an insurmountable financial hazard" for the aircraft industry.

One could look through the investment portfolios of many an investment trust in the early 1930's without finding a trace of an aviaton stock. Granted, there were two or three aviation investing concerns then as now. But among the others only occasionally would one be found with aircraft stocks. In these cases, Sperry Corp. and United Aircraft Corp. appeared initially.

A little later shares of Pan American Airways began to appear in some investment portfolios; still later the stock of Douglas Aircraft was sparingly added. By 1939, the trusts had made commitments in a few more airlines, such as American, Eastern, and United. Then Bendix began to appear in the lists, as well as a few plane makers such as Grumman and Lockheed.

Today it's quite different. Some investment companies still do not hold aviation stocks. But a study of the investing companies mentioned above shows that the stocks of 15 airlines were held in the aggregate at the 1945 year-end, along with stocks of 11 plane makers and four aircraft accessory or instrument concerns. The percentage of aviation stocks held to total investment holdings ranged from 100% for National Aviation to 1.9% for Massachusetts Investors Trust.

Generally the airline stocks are more popular with the investment companies than are securities of the manufacturers, as is shown by the fact that the 15 companies studied held airline stocks valued at approximately $19,000,000 at the close of 1945, compared with holdings of $9,250,000 in manufacturing organizations. There may have been some changes since Jan. 1, but the overall picture is well illustrated in Table I.

It will be noted that Pan American Airways continues to be the favorite airline stock so far as the investment companies are concerned, although substantial holdings of this equity were sold during 1945. United Air Lines was a close second, with Northwest, Eastern, and American following in that order.

In the manufacturing group, Bendix and Thompson Products—many of whose products are also sold in the automotive field—are the most popular, with Douglas Aircraft and the preferred stock of United Aircraft next in line.

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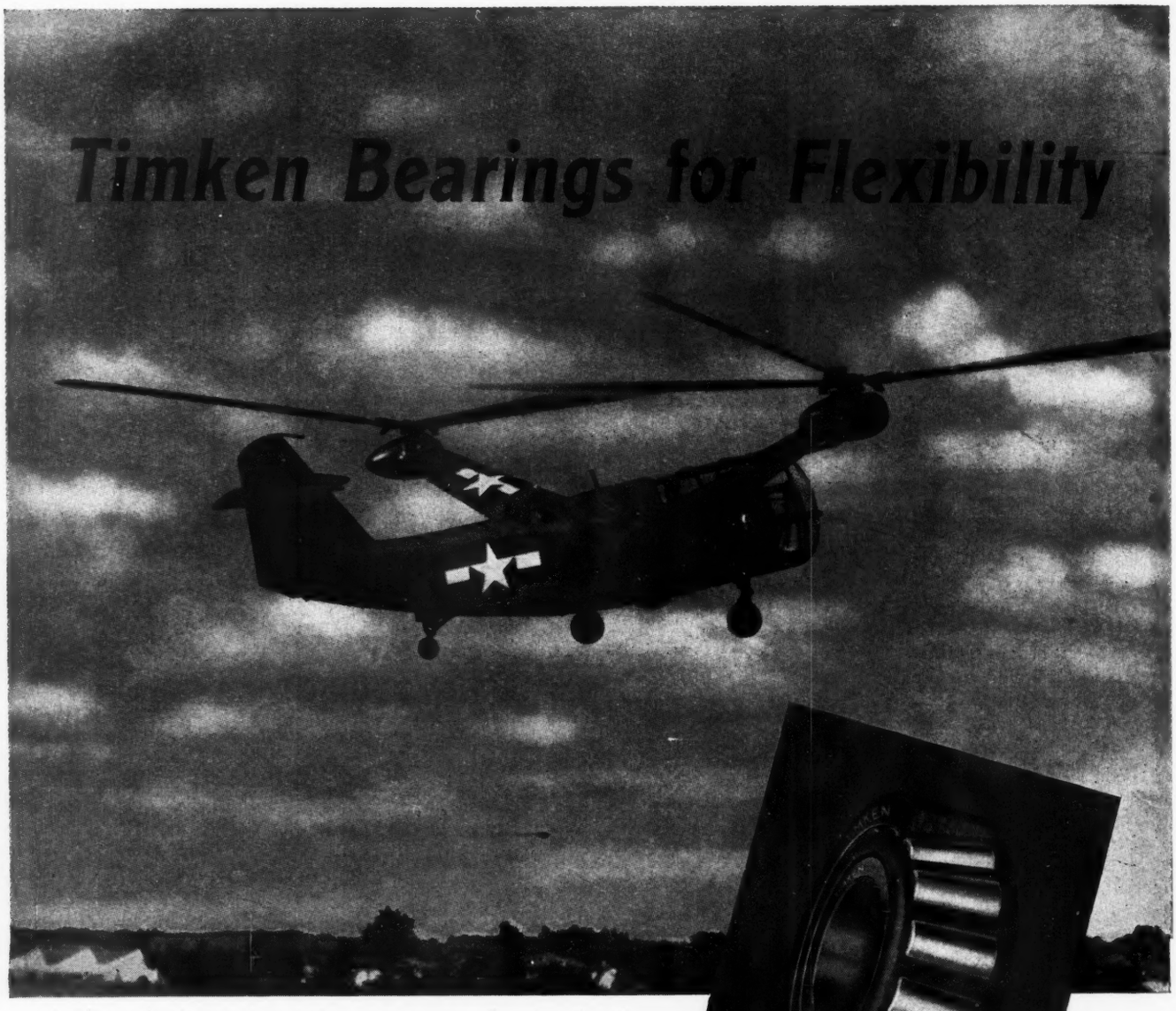
Table I—Airline and Aircraft Stocks Held by Investment Trusts

Airlines	Trusts Holding	Shares Held 12/31/45	Value 12/31/45
American	3	22,200	$1,842,600
Am. Overseas	1	555	44,400
Braniff	1	4,000	132,000
Colonial	1	3,700	158,000
Chi. & Southern	1	5,000	165,000
Delta	1	2,100	128,000
Eastern	6	22,600	2,649,500
National	1	4,800	164,000
Northwest	3	51,900	2,762,925
Pan Am. (rights)	4	47,935	627,400
Pan American	7	73,000	4,055,800
PCA	1	10,000	435,000
PCA bonds	1	.....	319,000
TWA	2	15,000	1,034,500
TACA notes	1	.....	187,500
United	4	.....	4,020,175
Manufacturers			
Air Assoc.	1	479	$7,500
Avco	1	30,000	300,000
Avco pfd	1	1,500	91,500
Bell	2	16,500	431,000
Bendix	4	46,000	2,484,000
Boeing	1	5,000	157,000
Convair	4	20,500	677,750
Curtiss Wr. A	..	6,000	165,000
Douglas	3	8,500	728,000
Grumman	3	8,000	417,000
Lockheed	3	31,500	1,329,000
Martin	2	1,600	64,100
No. American	2	29,000	395,000
Republic	2	14,000	233,750
Sperry	2	7,000	248,500
Thompson Prod.	2	15,000	870,000
United Aircraft	2	7,000	242,500
United Aircraft pfd.	3	4,600	519,500

Table II—1945 Investment Trust Changes In Airline and Manufacturing Stocks

Airlines	Bought	Sold
American	6,000	.....
Braniff	.....	5,000
Chi. & Southern	.....	4,000
Colonial	3,700	.....
Delta	2,100	.....
Eastern	4,100	.....
Midcontinent	.....	15,000
National	.....	3,200
Northwest	400	.....
Pan American	800	21,365
Pan American (rights)	1,900	.....
PCA	.....	9,500
TWA	2,000	500
TACA	.....	6,000
Manufacturers		
Air Associates	.....	1,200
Bendix	3,500	500
Bell	.....	150
Boeing	.....	6,600
Convair	.....	9,600
Curtiss-Wright A	1,000	9,400
Douglas	.....	2,100
Grumman	1,000	500
Lockheed	.....	900
Martin	1,600	.....
No. American	5,000	.....
Northrop	.....	2,400
Republic	.....	2,000
Sperry	2,000	.....
Thompson Products	3,000	5,000
United Aircraft	.....	11,500



On the Platt-LePage laterally-opposed XR-1 Helicopter used by the Army Air Forces, Timken Roller Bearings give the swivels and landing wheels the free flexibility of movement necessary for easy and safe handling under all take-off and landing conditions and on the ground.

"An important feature of this aircraft is the substantial landing gear with full 360-degree swiveling wheels at three points. Timken Bearings give it great freedom of movement and load-carrying capacity. Timken Bearings are also used in the wheels, where they amply care for any loads developed by this swiveling action while on the ground," writes Joseph F. Dempsey, administrative assistant to the President of The Platt-LePage Aircraft Company, and adds, "This company's post-war commercial program will include the use of Timken Bearings in the construction of its typical twin-rotor Helicopter."

If you have a landing gear problem for which flexible movement, stamina, light weight, radial and thrust load-carrying capacities, smoothness, ease and safety of operation *plus* economical operation are the answer, write us today. We'll be glad to make recommendations. The Timken Roller Bearing Company, Canton 6, Ohio.

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TAPERED ROLLER BEARINGS

FOR **BETTER DESIGN**

Skyraider's High Performance Stems From Pin-Point Designing

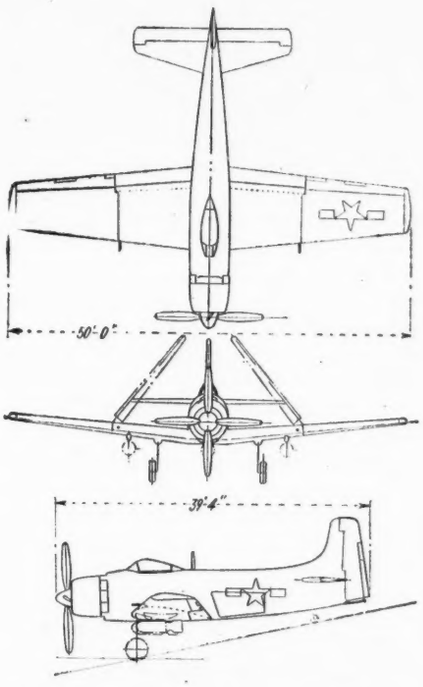
PART I

By E. H. HEINEMANN, *Chief Engineer, El Segundo Plant, Douglas Aircraft Co.*

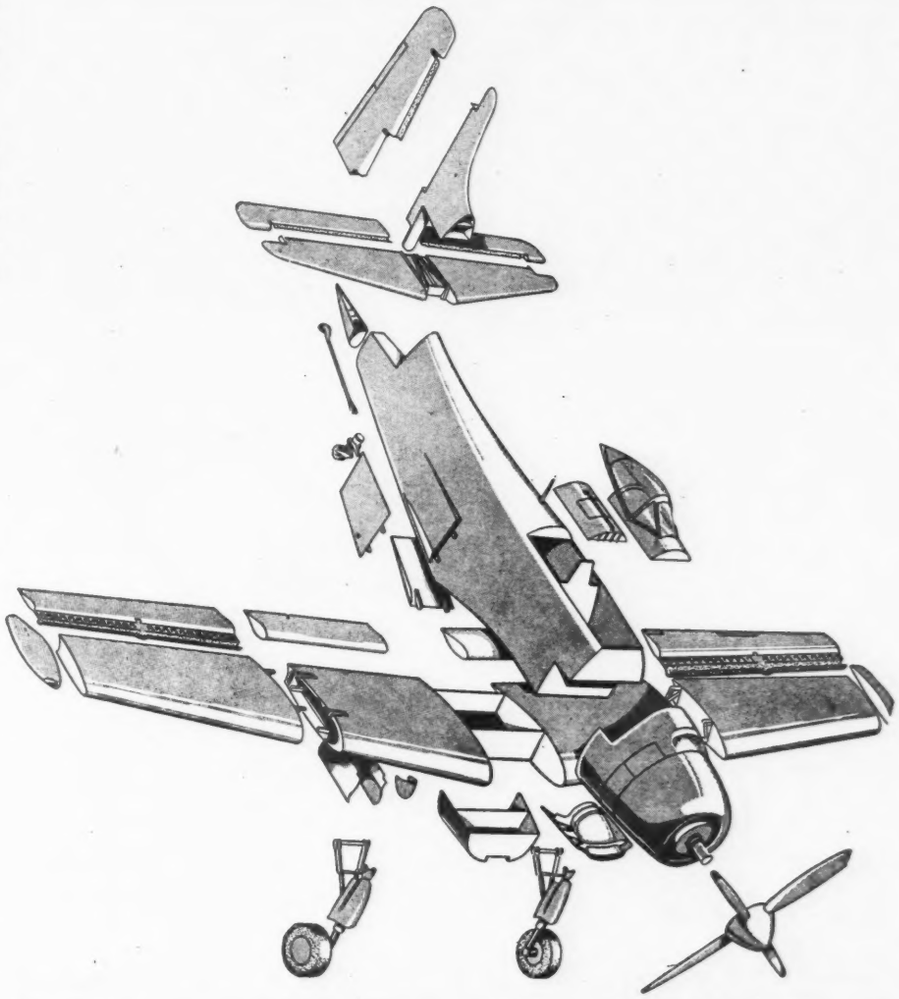
Faced with boosted requirements for weight reduction and increased lift, Douglas engineers set their goal even higher than demanded — to create a better-than-expected carrier-based dive bomber. . . . First engineering study of the BT2D.

A SHOWER OF INQUIRIES concerning design arrangement usually comes from the aviation public, following the debut of a new airplane. And the advent of the Douglas BT2D-1 Skyraider presented no exception to this custom. Immediately after press release on the craft, a multitude of queries were put: Why no bomb bay? Why fuselage dive brakes, etc.? The accompanying analysis—supplying the design-thinking behind the project—is intended to answer these numerous questions.

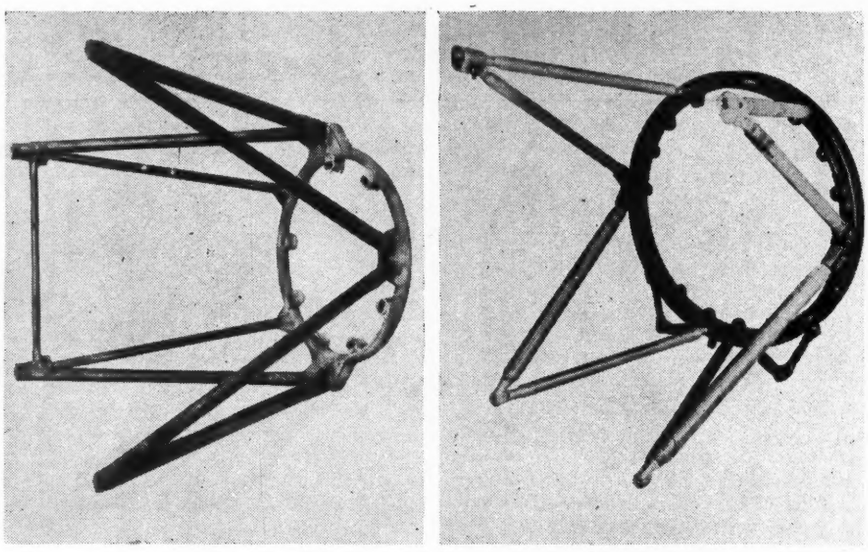
The Skyraider was conceived in June, 1944, when it was found necessary to develop a modern single-place long-range high-performance dive bomber of much greater striking power than the prewar-designed two-place dive bombers then

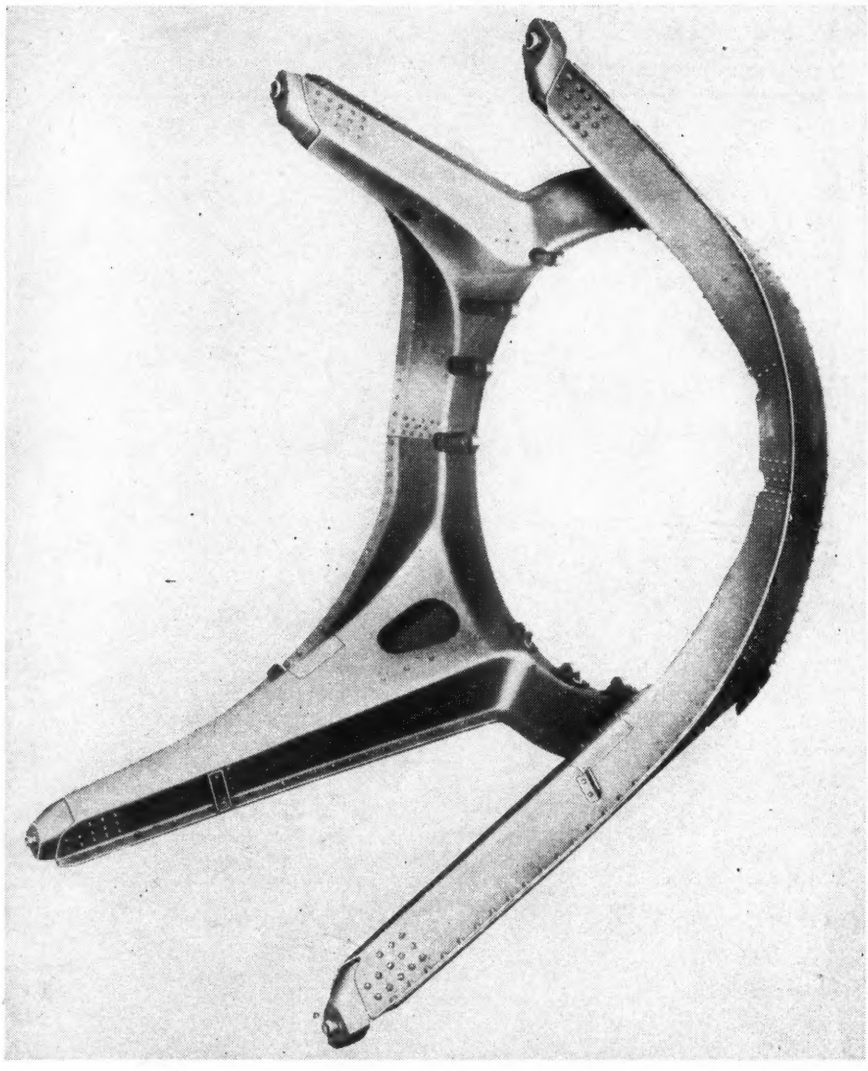


Three-view aspect of Douglas BT2D-1 Skyraider—carrier-based dive bomber, with bombs slung externally. Left dive brake is seen in insignia area on fuselage side.



Exploded relation showing major components of Skyraider. Simplification features include continuous center wing and horizontal stabilizer, single fuel cell located in space behind cockpit rear armor plate, bubble type cockpit enclosure, fuselage dive brakes (bottom and side), and elimination of bomb bay.





Evolution of BT2D simplified mount is seen in this comparison with Douglas SBD and BTD units: SBD hand-torch-welded mount (top left) had usual disadvantages of internal welding stresses, required normalizing and Magnaflux inspection, and entailed high rejection rate. BTD flash-welded unit (top right) was improvement over SBD mount, but had disadvantage of many joints. BT2D sheet metal mount (above) eliminates welding and features joint reduction and accessibility to engine and equipment.

in service. Specifically, the Douglas BTD dive bomber, under development during peacetime, first as a two-place, then as a single-place airplane, was discontinued in favor of the BT2D Skyraider.

New Requirements

Like the many other peacetime developments, the BTD did not contain the many features which were considered necessary for military requirements as the result of combat experience gained during the first few war years. Thus, the new requirements established for the BT2D, as compared with the BTD, included: Shorter takeoff distance, increased combat radius, increased rate of climb, greater load-carrying ability, and greater stability and control—characteristics, adding up, collectively, to fundamental design requirements of more lift and less weight.

At the same time it was apparent that the old peacetime planes offered poor considerations of utility and maintenance —spending, for various reasons, too many hours on the ground and not enough in the air.

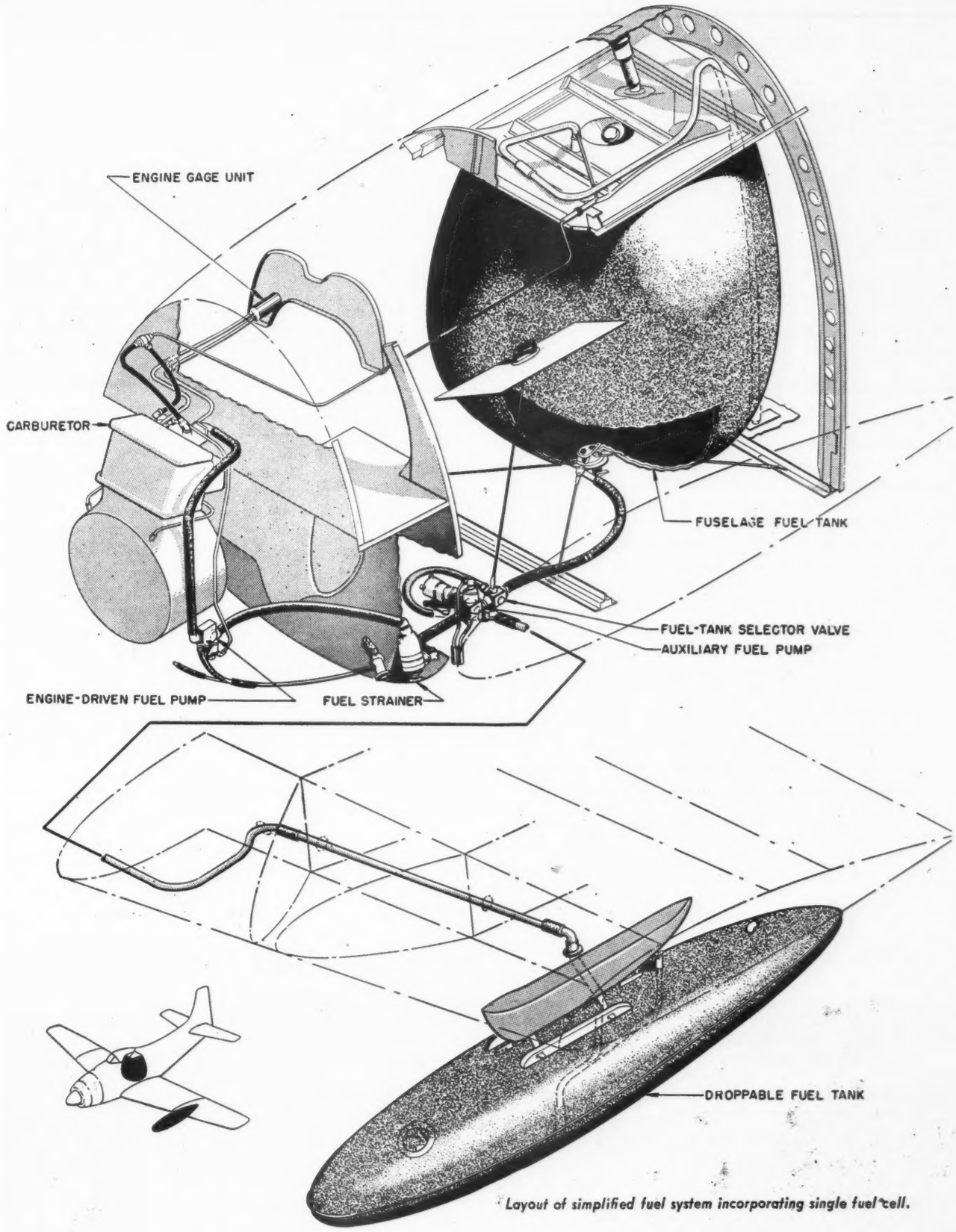
Hence, it was decided that to constitute a successful design, the Skyraider must embody the following improvements over the BTD: (1) Weight reduction from 18,000 to 16,120 lb., (2) increase of maximum lift coefficient from 1.8 to 2.0, and (3) improved utility by reducing time, by 50%, for fueling, arming, and servicing and maintenance details.

Weight Reduction

The guaranteed weight of 16,120 lb. was fixed by the Bureau of Aeronautics as a reasonable limit, based on both the consideration of weights of other similar types and the concession that the bomb bay could be eliminated and a tail wheel used instead of the BTD nose wheel installation.

However, knowing how easily weights can be exceeded, a target underweight value of 750 lb. was chosen and each engineering group was assigned its proportional underweight bogey figure. Along with this went some rigid design policies. One was that no part could be overweight unless an equivalent weight was saved elsewhere. Another was that any indeterminate structure or part that could not be designed to minimum weight requirements would be strength-tested rather than add an arbitrary safety factor, thus affording a uniform positive margin.

To impress the designers with the importance of saving weight, they were furnished bulletins illustrating, in simple fashion, effect on performance, as follows:



Layout of simplified fuel system incorporating single fuel cell.

Saving 100 Lb. Weight In Design of BT2D Will Result in—

Reduction in carrier takeoff....8 ft.

or

Increase in combat radius..... 22 naut. mi.

or

Incr. in range.....60 stat. mi.

or

Incr. s. l. climb.....18ft./min.

or

Increase in high speed....0.3 mph.

The usual question was asked by the designers: How much additional cost is justified to save a pound? A figure of $10 per lb. was assumed as a reasonable guide, based on tooling for a quantity of 500 planes—an assumption which

Comparative Design Factors—SBD, BTD, & BT2D

	SBD	BTD	BT2D
Gross weight (lb.)	8,250	18,000	16,120
Airframe weight (lb.)	4,387	8,564	6,295
Number of engineering drawings	2,722	5,235	2,381
Die fabricated parts			
Aluminum alloy forging drawings	59	139	56
Aluminum alloy forging pieces	286	359	56
Steel forging drawings	26	78	34
Steel forging pieces	62	182	82
Aluminum & magnesium sand casting drawings	88	150	67
Aluminum & magnesium sand casting pieces	117	189	74
Fuel system			
Number of tanks (bulletproof)	6	5	1
Tank removal time (manhours)	144	72	1.6
System weight (lb./gal.)	2.45	1.73	.93
Filling time (min., 1 man)	12	13	5
Oil system			
Number of radiators	1	2	1
Length of lines (ft.)	7	10	5
System weight (lb./gal.)	8.64	7.55	4.39
Power plant			
Weight of engine mount & cowling, forward of firewall (lb./hp.)	0.154 (Based on 1,300 hp.)	0.178 (Based on 2,500 hp.)	0.119 (Based on 2,500 hp.)

proved to be very reasonable for this particular project. It is now felt a figure of $15 or $20 per lb. might be entirely satisfactory for combat airplanes of this type. (This rule would actually vary for other types and in other plants.)

Results of this vigorous weight-saving policy were extremely gratifying. Final weighing indicated the weight to be 1,800 lb. under the contract guarantee. Thus, the normal military bomb load immediately increased 1,000 lb., and many other items of equipment have since been added to make the airplane more useful without affecting strength and performance.

Typical examples of weight-savings (lb.) in the BT2D over the BTD, as a result of basic simplification and careful design are:

Simplified fuel system.....270
Short carburetor- and oil- cooler-ducts instead of cowl leading edge type..... 50
Fuselage dive brakes..... 70
3,000 psi. against 1,500 psi. hydraulic system..... 50
Elimination of bomb bay.....200
Bubble type cockpit enclosure... 40
Powder displacing gear, instead of mechanical 40
Continuous center wing instead of 2-piece.....100
Continuous horizontal tail instead of 2-piece..... 20

These improvements also resulted in many indirect savings in secondary structure and equipment.

Lift Improvements

It was decided to depart from the modern trend to high speed 65-series airfoils as used on the BTD, in favor of a higher maximum lift section of the NACA 2400-4400 group, realizing, meanwhile, that a slight penalty in high speed might result. However, in reality, reduction in maximum velocity because of airfoil section selection amounted to less than the gain made through improved detail design.

The overall improvement in lift can best be described by the summary given below:

Maximum lift coefficient of BTD (actual) 1.8
Improvement because of change from 65 to 2400–4400 airfoil (estimated) 0.2
Improvement because of improved stability and control..0.1
Maximum lift coefficient of BT2D (actual) 2.1

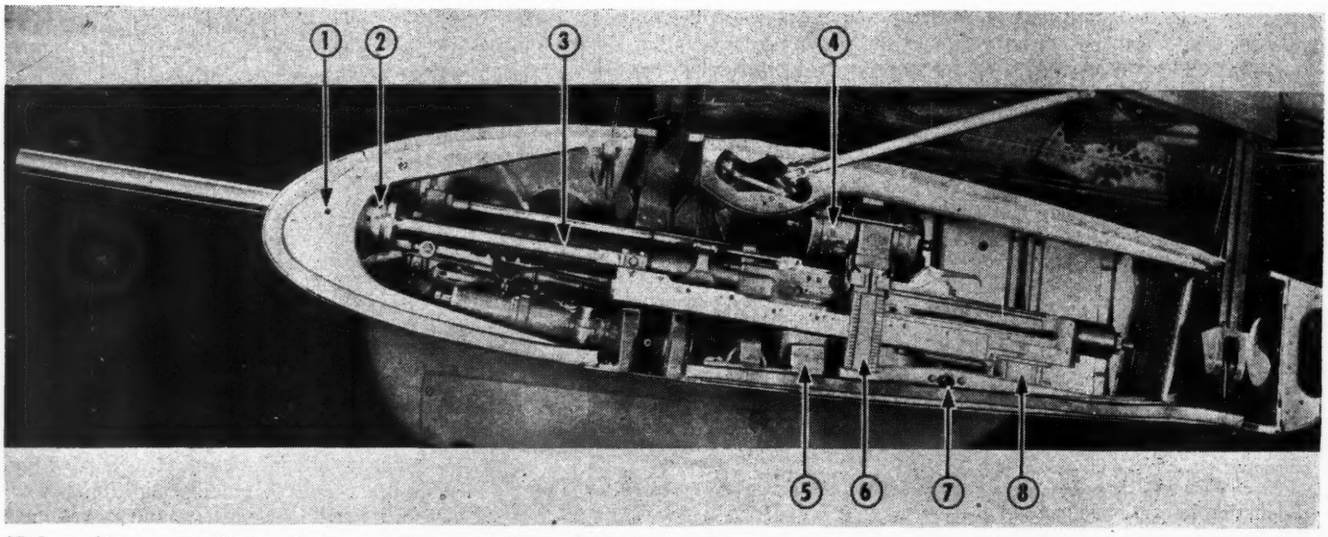
It is believed the BT2D actual lift coefficient of 2.1 instead of the predicted 2.0 is attributable to the excellent low speed flying characteristics, which permit realization of the full potentialities of the wing, with safety.

Fundamental Simplicity

To achieve the high degree of utility and light weight that characterizes the Skyraider, great care was given to the arrangement of equipment and structure. Thus, by making many layouts and constructing several mockups an arrangement was finally obtained permitting all the internal fuel to be carried in one tank instead of the five used in the BTD. This alone resulted in a considerable reduction of fuel system weight, and at the same time, reduced tank replacement time to a small fraction of that for the BTD and SBDs. Also, a single fuel tank frees pilot of the responsibility of tank switching, and, according to recent operational statistics, will prevent many power failures attributed to tanks running dry.

Examples of what was accomplished by simplification and careful arrangement are illustrated in the accompanying tabulation of comparative design factors.

Concluding Part II of this analysis will appear in May AVIATION.



BT2D machine gun installation showing excellent accessibility obtained without use of special access doors when wings are folded: (1) Hole for ring sight, (2) front mount, (3) retaining rod, (4) feed mechanism, (5) case ejection chute, (6) link ejection chute, (7) rear mount keyway-plate support, and (8) gun-firing solenoid. Rack for bomb or droppable fuel tank is seen below wing.

Composite-Engine Aircraft —As a Basic Conception*

By **ROBERT B. JOHNSTON**, *Chief Aerodynamicist,*
and **HAYDEN S. GORDON**, *Former Assistant Chief of Development, Ryan Aeronautical Co.*

Here's the engineering philosophy behind the unique power plant installation of the Ryan FR-1 Fireball—coupled with a clear analysis showing how a combination of piston and turbojet power units offers distinctive performance advantages over individual use of either of these types.

WITH THE ADVENT of the Ryan FR-1, the composite-engine aircraft made its debut. By composite-engine craft is meant a plane having two dissimilar power plants—in the FR-1, a 9-cyl. R-1820 Wright Cyclone and a GE I-16 turbojet of 1,600 lb. static thrust.

Before comparing the performance characteristics of the composite-engine craft with those of the piston engine plane and the jet plane, a general description of the FR-1 is presented.

The FR-1 is a low-wing land or carrier-based single-seat monoplane with tricycle gear. External appearance conforms, in general, to that of conventional single radial-engine fighter plane, but is marked by the length of the fuselage forward of the wing and particularly, the location of the cockpit with respect to the wing leading edge—affording improved visibility for flight and landing approach.

In the composite-engine aircraft the turbojet engine is used when the pilot demands a short takeoff run, takeoff with overload, high rate of climb, or high top speed, or when the piston engine fails. In the latter case, the safety feature of the twin engine plane is achieved, although at the expense of range compared with that of piston engine cruising condition. Thus, in addition to simplification of the problem of supply, it is preferable to use the same fuel—high octane gasoline—for both the piston engine (forward) and the jet engine (aft) and arrange the fuel system to permit consumption of the entire supply by either engine.

For the turbojet installation in the FR-1, the practical combat radius requirements for Navy Class VF airplanes are supplemented by requiring a 30-sec. warm-up at full static thrust, 30 sec. for takeoff at full throttle, and 10 min. idling and 10 min. at full throttle at 15,000 ft.

Particular attention has been given to the simplification of techniques for starting and operating the turbojet engine. The electrical system is energized from the battery-generator system of the forward engine—the turbojet engine generator being omitted—through an overload contactor reset by repeat operation. The contactor is in turn operated by a switch combined with the turbojet fuel selector valve so that the system is dead with the selector valve in the "off" position. A throttle lever is included in the control quadrant provided for the forward engine. A pushbutton is situated in the top of a throttle grip and actuates the starting contactor. Turbojet throttle valve is a combined throttle and stopcock. The throttle quadrant has a latch stop separating the travel of the lever for the shutoff and throttling actions.

Instrumentation includes a tailpipe temperature indicator, non-sensitive tachometer, and a combined fuel and oil pressure indicator—all three located in the lower right corner of the panel, below the forward engine instruments.

Turbojet starting is accomplished by selecting the fuel supply, depressing the button on the throttle until starting rpm. is attained, and then advancing the throttle in accordance with normal starting technique. When the throttle is retarded the latch stop limits the travel to the idling condition. Time required for starting is dependent upon the windmilling speed of the engine and upon altitude, although 25–45 sec. seems to be normal period to achieve full thrust up to altitudes of 25,000 ft. The throttle may then be used coincidentally with the forward engine throttle for maneuvering, or may be operated independently. The rapid speed with which the engine can be started is especially desirable in event of forward engine failure. Shutdown is achieved merely by closing the throttle past the idling latch stop.

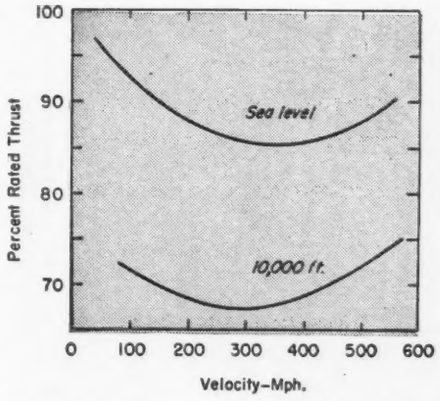


Fig. 1. Average curves of thrust vs. velocity for jet engines.

The Wright 1820-72W engine is installed in the nose in an NACA type cowl, drives a three-bladed Curtiss controllable pitch propeller, and has a single-stage two-speed supercharger which gives engine critical altitudes of 5,000 and 13,500 ft. Individual jet exhaust stacks discharge into four troughs recessed in the fuselage contour. Water injection permits utilization of combat power for approximately 10 min.

Since the installation of the turbojet is characterized by several unique features, it will be described in more detail, and some of the thinking underlying its design and problems encountered will be outlined.

The airplane is built with a transverse split-line between fuselage center section and tailcone section. An engine change may be accomplished by removal of four bolts and breaking of electrical quick-disconnects and fuel and control lines. Tailpipe is disconnected by removal of a circumferential clamp band, then front support strut and trunnion point pins are removed, and the engine is rolled forward on a trolley riding on an integral track. At the most forward point of travel a crane hook can be inserted into a loop attached to the trolley and the entire engine assembly swung away from the tailcone. Engine assembly includes

* Based on a paper presented at the Aircraft Gas Turbine Engineering Conference at Swampscott, Mass., sponsored by General Electric Co. and AAF.

all controls, valves, oil tank, ignition system, plumbing, wiring, electrical contactor, and pressure transmitters and associated parts.

The engine is supported at the trunnion points on the compressor diffuser casting by pins inserted from the outside of the airplane through forged fittings attached to a double bulkhead ring in the tailcone. A strut attaches the forword support point to a fitting near the main bulkhead at the tailcone split-line.

Within the airplane, access to the engine is through four hinged doors, two at the rear of the engine, for servicing the ignition and burner nozzle systems, and two at the forward end. Through the latter, panels on each side of the shroud and, successively, panels on each side of the fairing may be removed for access to the accessories on the engine, the barometric control, and the oil tank.

Air Induction System

Air is introduced into the duct system leading to the engine through inlets situated in an extension of the wing leading edge on each side of fuselage. The wing extension serves to raise the critical Mach number of the wing-fuselage juncture and to increase the space ahead of the front wing spar for the inlet elbows. Wing inlet lips have a stagger, or inclination of 35 deg. with respect to the normal of the wing chord line. Extensive wind tunnel testing on a 1/5-scale model of the plane was necessary to develop the contours of the upper and lower lips, to orient the inlet opening, and develop the wing contours in the area aft of the opening to obtain the maximum lift coefficients and pressure distributions characteristic of the basic low-drag series airfoil section—all for the range of inlet velocities attendant with the jet engine in the non-operating, idling, and full throttle conditions.

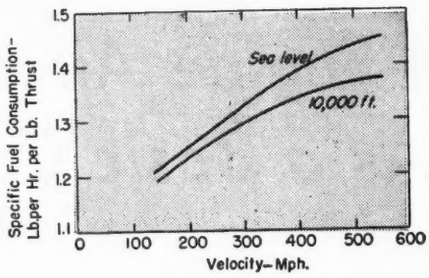


Fig. 2. Average curves of specific fuel consumption vs. velocity for axial flow jet engines.

Testing was ably conducted by the staff of the Ames Aeronautical Laboratory of the NACA in California. Four turning vanes in each elbow direct the air inward and upward toward the fuselage. Within the fuselage, additional elbows (this time with two vanes each) direct the air aft over the top surface of the wing center section. The duct is integral with the center section from the front to the rear spars, but the air flow is maintained as a separate stream from each wing inlet until a station shortly aft of the rear spar is reached. Location of the two sets of turning vanes and the need for a center section dividing strip were determined by bench tests on a 1/5-scale Plexiglas model at Ames. (It is worthy to note that the 1/5 scale bench flow tests made there showed very good correlation with the full scale tests conducted at Cleveland.)

From the rear spar, the duct contours change to a circular section and enlarge into a bell-shaped enclosure of the entire forward portion of the turbojet, attaching to the mating flanges between the diffuser elbows and the combustion chambers to which the engine baffle aft of the rear compressor inlet attaches. The accessory section of the engine is enclosed in a fairing which, together with the outer shroud assembly, permits controlled expansion from the wing inlets back to the compressor inlet areas.

This type of ducting was adopted to minimize losses, insofar as possible, attendant upon the sudden expansion of the air if it were discharged into a plenum chamber formed by the fuselage tailcone. Also, it was considered that such a system would give a uniform distribution of air to the compressor inlets and avoid possible non-uniform combustion chamber operation. This is analogous to the need of obtaining a uniform velocity distribution over the top deck of the carburetor on a mechanically supercharged piston engine. Weight of the components required by this design is offset by the lack of pressurization requirements in the design of the fuselage, access doors, and sealing.

By the provision of an annular slot at the juncture between the section of the duct fixed to the fuselage center section and the shroud assembly previously referred to, which is supported by the engine, the ventilation requirement is met, low energy air is removed from the duct immediately prior to the maximum rate of expansion, and the joint between the fuselage center section and tailcone assemblies is made without the need for

Table I—Weight Breakdown of Comparative Airplanes

Model	Conventional Power Plant, Combat Bhp. @ S. L.	Jet Power Plant, Static Thrust	Weight of Power Plants[1]	Weight of Fuel	Weight of Fuel Tanks[2]	Weight Loaded	Remarks
A	1,525	1,600	2,840	2,280	380	10,700	Composite design
B	3,525	.....	4,710	677	123	10,700	Same max. velocity as A at S.L.
C	2,460	.....	3,830	1,430	240	10,700	Same rate of climb as A at S.L.
D	.....	2,900	1,450	3,470	780	10,700	Same max. velocity as A at S.L.
E	.....	3,740	1,870	3,200	530	10,700	Same rate of climb as A at S.L.

[1]Assumed weights of power plants and installation are: Conventional power plant, including propeller and accessories, 1.335 lb./combat hp.; jet plant, 0.5 lb./lb. of thrust.
[2]Assumed as 1 lb./gal. of fuel.

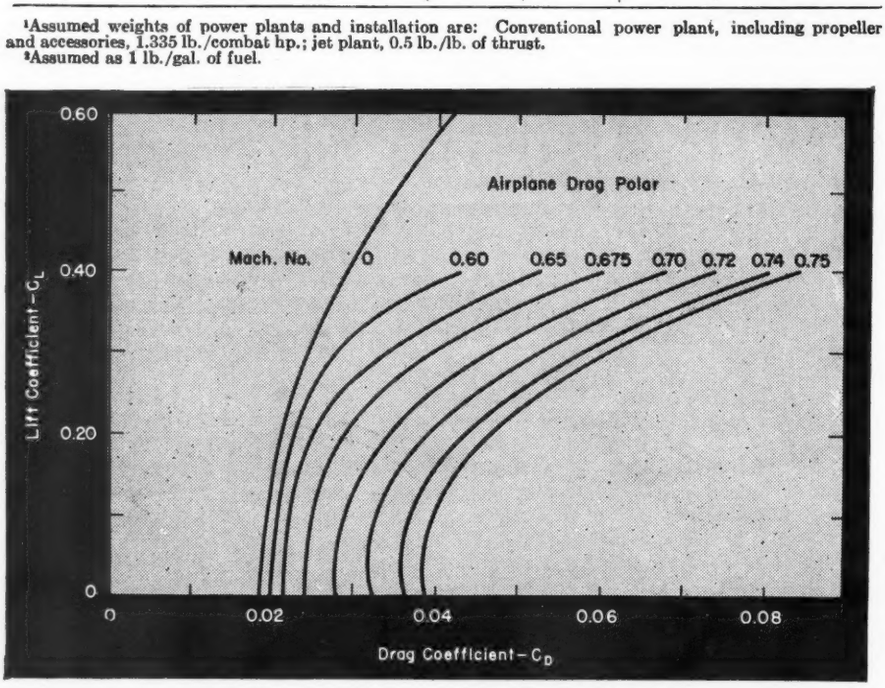


Fig. 3. Airplane polar curve corrected for Mach number.

providing a pressure tight seal or mechanical attachments for the duct. The ventilating air flow plus the flow through the turbojet, when windmilling, is sufficient to maintain the wing inlet velocity ratios within the required range when the airplane is flying on the forward engine only. Thus, no shutoff of any type is required.

Composite-Engine Plane Characteristics

To illustrate the characteristics of a composite-engine installation it was decided that the performance of five hypothetical planes should be computed. All of them would be comparable in that the same drag polar, wing area, span, and gross weight would be used. Wing loading would be relatively light, since Naval aircraft must have relatively low landing speeds—approximately 80 mph.

These planes are identified by the letters A to E. Plane A is a composite-engine type (not the Ryan FR-1), whereas planes B and C are powered with piston engines. It is assumed that the piston engines are capable of developing constant combat power from sea level to 10,000 ft. Plane B has been designed to have the same sea level top speed as plane A, and plane C has the same sea level rate of climb as plane A. Planes D and E are jet-propelled. Again, one of these has been designed to have the same sea level high speed as plane A, while the other has the same sea level rate of climb as plane A.

Weight of each plane, less power plant and fuel, was assumed to be 5,200 lb. Gross weight has been assumed as 10,700 lb., including external droppable fuel tanks. Difference between the two weights was assumed to be power plant and fuel.

Weight of conventional power plant, including propeller, oil tank, and miscellaneous accessories, was assumed to be the 1.87 lb./normal hp., established by the Society of Aeronautical Weight Engineers. It was further assumed that the piston engine could produce a combat power of 1.40 that of normal sea level power at all altitudes up to 10,000 ft., based on currently available military engines. This gives an effective piston engine installed weight of 1.335 lb./combat hp.

After a study of the available jet engines, it was decided that an installed weight of 0.5 lb./lb. of thrust was quite reasonable. Fuel tanks were assumed to weigh 1 lb./gal. With these assumptions we arrived at weight breakdowns as shown in Table I.

It will be noted that with these assumptions, plane B has the least fuel capacity. This occurs because the piston engine that is needed to obtain the same high speed at sea level as has plane A is large, hence the installation is very heavy.

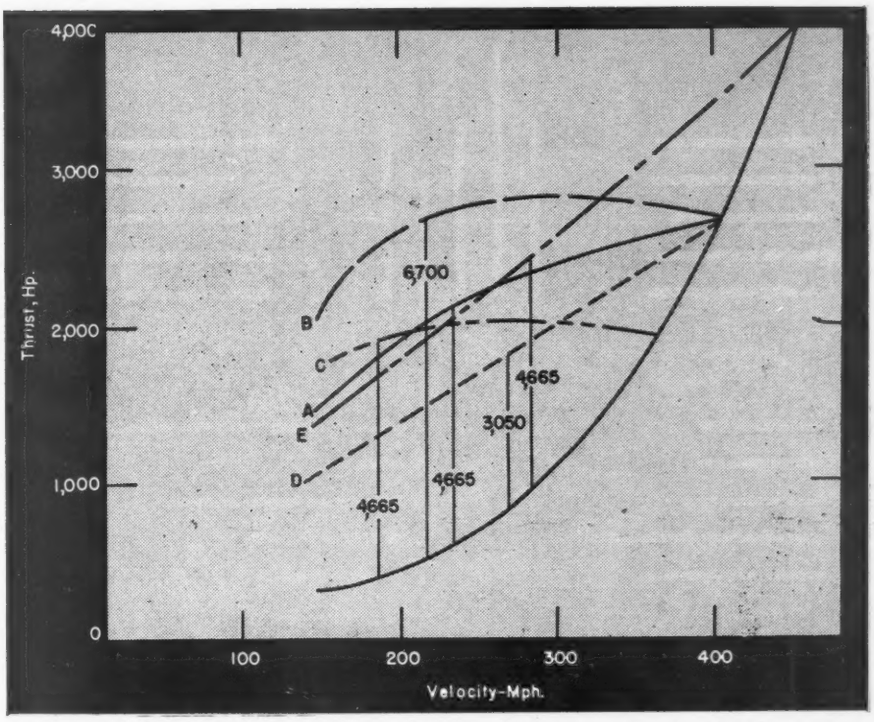


Fig. 4. Sea level power required and available curves for five compared craft (A, composite-engine; B and C, piston-engine; and D and E, jet-propelled).

Further investigation into the properties of jet engines (studies were made of all currently available and projected jet engines on which we had information) gave the average curves for thrust vs. velocity as shown in Fig. 1. At the same time, an average sfc. (specific fuel consumption) was determined. Here it was found that there is a considerable difference in fuel consumption between axial flow and radial flow jet engines. It was considered that any airplane using a jet power plant as its only source of power would use the axial flow type because of its lower sfc. Accordingly, the curves given in Fig. 2 are the average values for the axial flow jet engines previously mentioned.

For range calculations for the piston-engine planes it was assumed that sfc. was 0.45 lb./bhp./hr., which is considered to be an average consumption for the operational auto-lean condition, and that the cruising propeller efficiency was 0.65. Range in all cases was calculated at 15,000 ft. and at speeds for $L/D_{max.}$ for piston engines, and at speeds for minimum fuel consumption per mile for jet propelled planes.

The airplane polar curve corrected for Mach number is shown in Fig. 3. This polar was assumed to be the same for all craft. A wing area of 275 sq. ft. was used, and all performance calculations were made by conventional methods.

Fig. 4 shows the sea level power required and available curves for the five planes. Several points of interest will be noted: Of the craft which have the same high speed (planes A, B, and D), plane B (with reciprocating engine) has the highest rate of climb, although this occurs at the lowest speed. Plane D (with the turbojet) has the lowest rate of climb but at the highest speed. The composite plane has a *rate* of climb and *speed* for climb that lies between the two.

Let us now examine the three planes which have the same rate of climb. Here the high speed is the variant. Jet plane E has the highest top speed, whereas the conventional airplane has the lowest speed. Again, the performance of the composite-engine plane lies between that of the jet-propelled and the piston-engine planes. Also to be noted are the changes in speed for climb with the three types of propulsion.

Table II shows the results of various performance calculations made for the five airplanes. Maximum range at 15,000 ft. was calculated as previously explained. Here it will be noted that plane A has the highest range and plane B has a rather short range because of high power plant weight.

It should be noted that plane A flies, normally, on its reciprocating engine and that the jet engine is normally used for combat, takeoff, or emergencies. Hence, the range calculations are based upon the use of the piston-engine only.

Velocity for maximum range is the next item of interest. Here the differ-

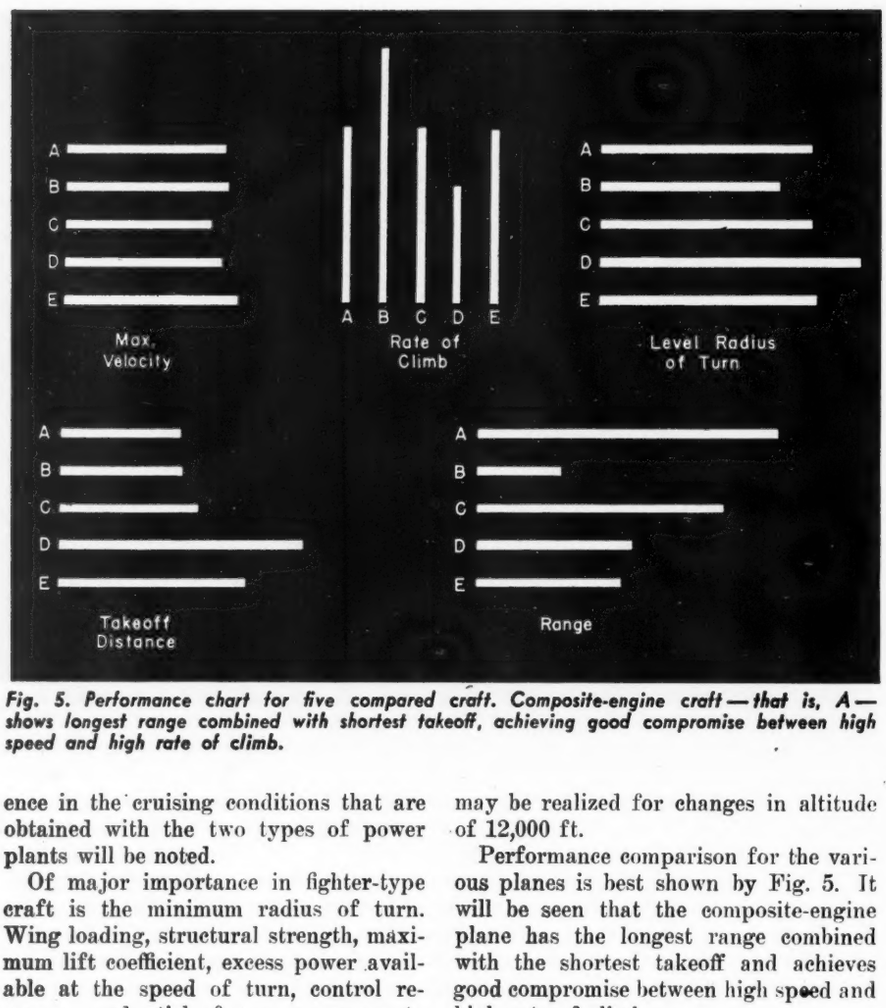


Fig. 5. Performance chart for five compared craft. Composite-engine craft — that is, A — shows longest range combined with shortest takeoff, achieving good compromise between high speed and high rate of climb.

ence in the cruising conditions that are obtained with the two types of power plants will be noted.

Of major importance in fighter-type craft is the minimum radius of turn. Wing loading, structural strength, maximum lift coefficient, excess power available at the speed of turn, control response, and stick forces necessary to execute the turn, all play a vital part in determining the minimum radius obtained in actual practice. No calculations can be made which cover all of these items. Any comparison made here must, of necessity, consider only the items of wing loading, structural strength, maximum lift coefficient, and excess power available at the speed of turn. Using this as a basis, it may be said that in airplanes of the same configuration with the same wing loading and allowable load factor, the one with the highest excess hp. at the speed in question will have the least radius of turn. This is borne out by the turn radii shown in Table II.

The same factors that are important in the radius of turn are also important in the zoom climb—a climb started from level high speed, pulling-up, and allowing the speed to decay until the speed for best climb has been reached. Because of the difficulties in calculating the loss of energy in the pull-up, no comparison will be made here. We can only indicate the tremendous advantages to be gained by easy maneuverability and light wing loadings. It is our experience that rates of climb from 2,000 to 2,500 ft. per min. in excess of the normal rates of climb may be realized for changes in altitude of 12,000 ft.

Performance comparison for the various planes is best shown by Fig. 5. It will be seen that the composite-engine plane has the longest range combined with the shortest takeoff and achieves good compromise between high speed and high rate of climb.

Prospects of Composite-Engine Planes

Turbine-propeller power plants. We believe that the advent of the turbine-propeller power plant does not materially modify the general conclusions, for the composite-engine plane, outlined previously. The installation of a turbine of weight only slightly greater than that estimated for the piston engine, and of currently available power, will increase the airplane top speed about 100 mph. above that predicted for the piston composite-engine craft. An increase in gross weight and fuel capacity would be necessary. However, these would not be abnormal or prohibitive, but takeoff and rate of climb would be improved.

Even with the improved power-weight ratio of the turbine-propeller power plant, we still find the performance of the jet engine to be superior in this respect, and since the range of power required between speed for best range and top speed is achieved by operating the two engines in series rather than in parallel (by way of analogy with an electrical circuit), each engine is operating nearer its optimum for the various conditions.

By way of recommendations or suggestions for future development of turbine-propeller power plants, as based upon our studies, we shall emphasize primarily the need for good fuel economy for the cruising condition. Secondarily, the conflicting requirements of short takeoff run and high speed performance indicate the need for a solution of the propeller gear ratio problem, possibly by the use of a two-speed selective transmission, with high propeller rotational speed for takeoff and low rotational speed for cruising and high speed flight. This would result in a lower gross weight than the use of contra-rotating propellers and accomplish similar results.

Turbojet power plants. Since the use of the turbojet engine in the composite-engine plane is assumed, at present, to be limited to short periods, the most profitable course of development lies in the reduction of the sum of engine weight plus fuel weight for the assumed duration. Present assumptions result in the fuel weight representing about one-quarter of the total weight. Hence, it is evident that a sacrifice in fuel economy could be countenanced if a substantial reduction in weight were achieved.

The type and configuration of the turbojet engine is not critical as long as the engine is placed in the fuselage and comes within the dimensional limits set by the forward engine, cockpit, and other general requirements.

We have not yet made a study of the optimum ratio of powers of the two engines for a composite-engine plane but consider that if the static thrust of the jet engine in lb. is 1-1¼ the takeoff hp. of the piston engine, a relatively well-balanced design for the fighter-type aircraft will result.

Table II—Performance Summary

Model	A	B	C	D	E
Max. velocity @ S.L.	405	405	365	405	454
Max. velocity @ 10,000 ft.	428	433	392	413	460
Max. rate of climb	4,665	6,700	4,665	3,050	4,665
Vel. for Max. rate of climb	235	218	189	271	285
Max. range @ 15,000 ft.	1,854	505	1,520	950	880
Vel. for max. range @ 15,000 ft.	214	214	214	315	315
Min. hor. rad. of turn @ 250 mph.	1,134	959	1,132	1,391	1,140
Min. hor. rad. of turn @ 300 mph.	1,589	1,370	1,770	1,875	1,481
Min. takeoff distance (ft.)	639	655	726	1,291	994

How Flight Detonation Testing Keys Engine-Fuel Performance

By ROBERT J. CLARK and RICHARD M. ADAMS,
Staff Engineers, Atlantic Div., Pan American Airways

It has long been realized that precise data on aircraft fuel and engine detonation could help operators safely achieve far better economies and greater payloads for transport craft. Herein the authors reveal a successful system for gathering and interpolating such essential data under actual flight conditions.

UNTIL JUST PRIOR to World War II, almost all aircraft detonation work was carried out in the laboratory rather than in the air, and much of it was done merely on single-cylinder units. Although many interesting data were developed, they naturally failed to cover those variables that are solely inherent in the flight operation of an aircraft engine.

Thus "cushions" were built into operating limits to take care of the flight variables that were known to exist, in order to calculate their magnitude, which was not known. For an operator to attain maximum economies in operation in order to gain maximum payloads, it was necessary that actual flight performance be known, not extrapolated from ground tests.

For these reasons the authors were among those designated to carry out flight detonation tests on PAA's Clippers—safe economy being the end sought. Herein the reader will find outlined the theory behind the work done and how the tests were developed and carried out.

Fuel Characteristics

First let us consider the field of investigation in question. A typical mixture response curve is shown in Fig. 1. This is a plot of bmep. vs. fuel-air ratio for a single engine speed. The area beneath the curve is detonation free, whereas that above is in detonation. The hook on the right (rich) end of the curve illustrates a phenomenon known as rich mixture detonation. There are two knocking characteristics of an aviation fuel—one is cruising (lean), the other is takeoff (rich) response of fuel to the detonation tendency. The lean rating remained the only rating until approximately 1942. Since two fuels may react the same at cruising fuel-air ratios and have widely different detonation reactions at takeoff fuel-air ratios, it is necessary to incorporate both the lean (1C octane rating) and the rich (3C rating) in the specifications.

Hooks may be noted on both ends of the mixture response curve. The rich

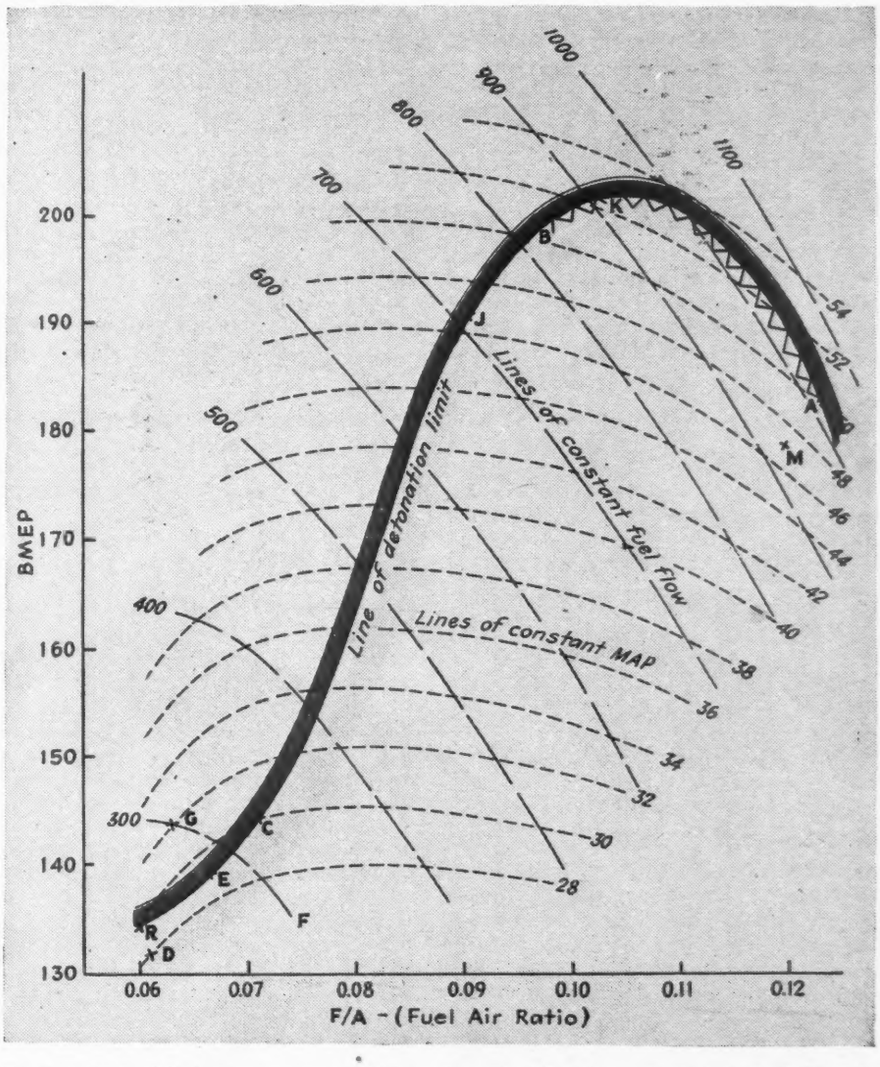


Fig. 1. Typical mixture response curve with lines of constant fuel flow and constant absolute manifold superimposed. This plot illustrates bmep. vs. fuel-air ratio for a single engine speed.

hook appears with some fuels but not with others. The lean hook on the bottom of left side of the curve is common to almost all fuels. It is, however, rather hard to determine and is of doubtful value, since the lean side of the hook usually occurs at fuel-air ratios much leaner than those used in actual operation—rough engines being encountered before mixtures this lean can be attained. Of the various explanations regarding the reason for the lean hook, the most cogent seems, to the writers, to be that below fuel-air ratios of 0.060 the mixture is so lean that it will barely support combustion, and is too lean to support detonation.

The mixture response curve shown in Fig. 1 has, superimposed upon it, lines of constant fuel flow and constant absolute manifold. Note that it is quite possible in the rich range to be in rich detonation, as at point A at the right end of the curve, and lean out the mixture at a constant manifold pressure to get out of detonation. Yet a continuation of the leaning process will bring the engine into detonation again, as at point B. On another constant manifold pressure line, the range could be leaned into detonation, as at point C, while further leaning will eliminate detonation, as at point R. This serves to emphasize the necessity of knowing, exactly, detonation limitations of a given engine installation operating with a given fuel. Disregarding these limits will result in piston failures similar to that shown in Fig. 2.

Fig. 2. Disregard for detonation limitations may easily result in piston failures, as shown above. Damage in this case extends from piston head to bottom of ring area.

Normally when flight testing is done, some considerable amount of ground test data is available. Consequently the takeoff rpm. operation need only be investigated within the range of fuel-air ratios of from .075 to full rich or to .110 if possible. One or two manifold pressure points are generally all that are necessary. In the cruise rpm. range, fuel-air ratios of .058 to .075 or .085 maximum generally cover the needed points adequately. Actually, mere determination of minimum boost points in this latter range of engine speeds may be adequate if comparatively simple operations are contemplated.

Minimum boost point is illustrated at point E in Fig. 1 and represents minimum manifold pressure at which detonation can be produced at that engine speed. If operation is kept below this manifold pressure, no detonation will be encountered at any fuel-air ratio. At medium cruise rpm.'s and at climb rpm.'s, it is advantageous to determine detonation limits for the fuel-air ratio

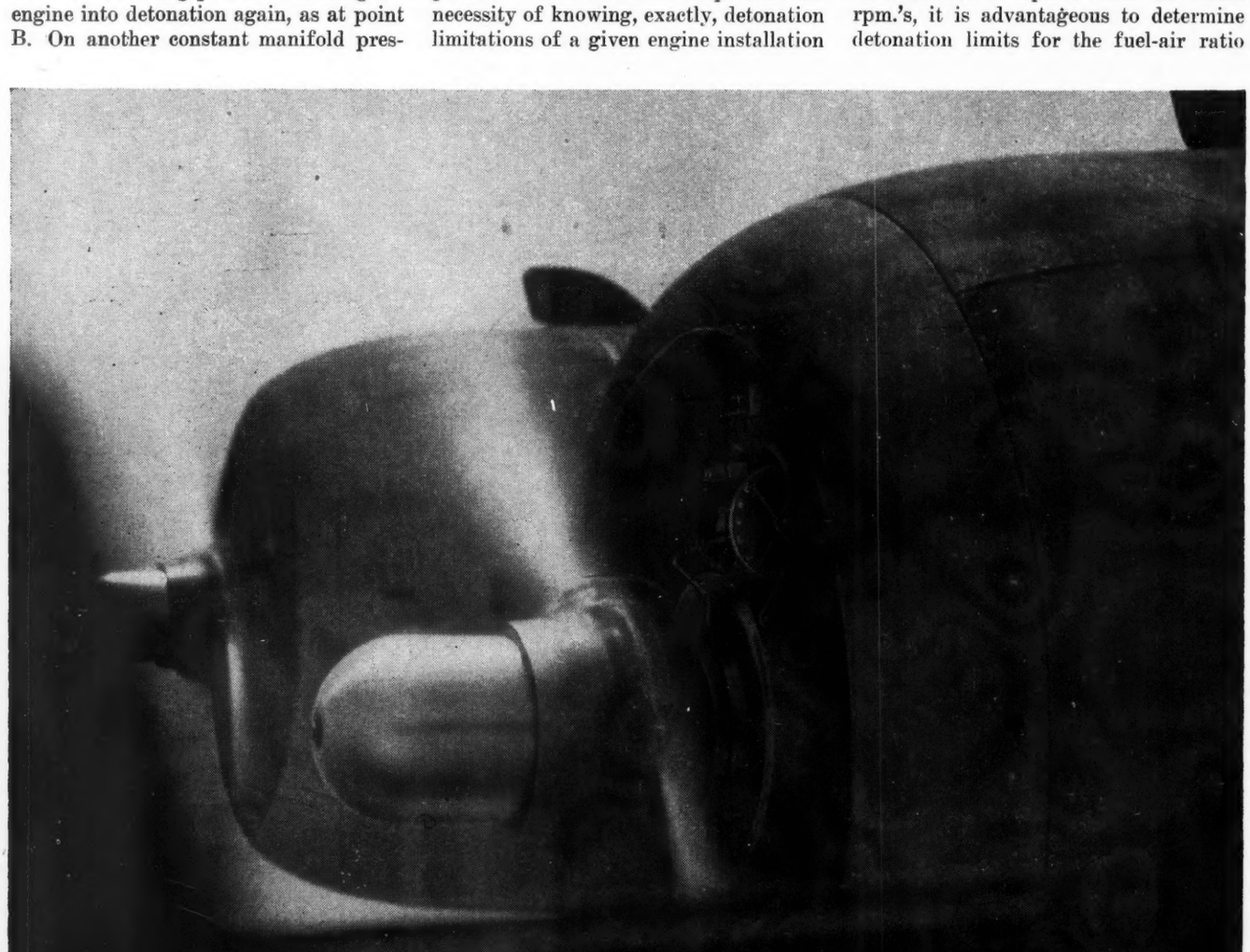


Fig. 3. Torquemeter nose installation on inboard engine of Douglas DC-4. Test engine should have nearly top allowable time since last overhaul in order to obtain realistic data.

range from .060 to .090. Again this can be simplified if the operation is already fixed and a check is being made only to determine the amount of cushion available at normal operating levels. In the latter case, controls may be set to the operating rpm.'s and manifold pressures, and mixture leaned out until detonation is encountered. It will be assumed that tests are being made to provide adequate data to allow the operator to set up the best operating limits and still be able to revise these limits at a later date to fit a different type of operation without further detonation testing.

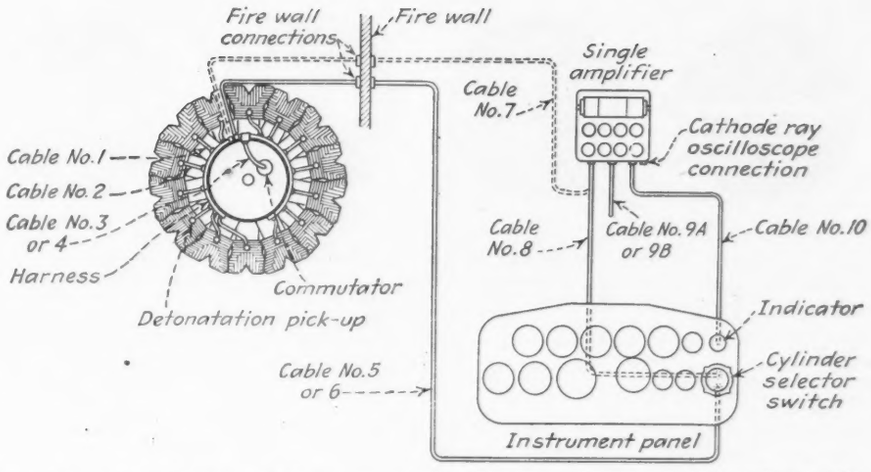


Fig. 4. Diagram of detonation detection apparatus, as developed by Sperry and described in this article. For observation of actual combustion pattern, an oscilloscope is connected to circuit.

Test Equipment

Use of multi-engine equipment facilitates flight testing, since power can be adjusted easily on the test engine without much concern for aircraft performance. We shall assume that the test engine is a radial aircooled type.

The engine on which tests are to be performed should be equipped with normal instrumentation, including a manifold pressure gage, also tachometer, carburetor air temperature gage, oil temperature gage, and fuel and oil pressure gages. Cylinder head temperature gages should be connected to a minimum of two heads, located on the hottest running cylinders. Cylinder base gages may be desirable, and they should be installed on each cylinder, since they can be used to indicate incipient piston failure. A fuel flowmeter, to measure adequately the complete range of fuel flows to be encountered, will be necessary. The engine must be equipped with a torquemeter to measure power output, with a bmep. gage, readily visible to observer and test operator. A torquemeter nose installation is shown in Fig. 3.

Detonation detecting apparatus must be installed. The type most frequently used is that developed and manufactured by Sperry Gyroscope Co. Essentially it consists of individual pickups on each cylinder, connected to a neon indicating tube through a commutator, amplifiers, and a selector switch. A simple diagram of this installation is shown in Fig. 4. The neon tube flashes when detonation occurs in any cylinder.

For good results an oscilloscope should be hooked into the circuit so that the actual combustion pattern may be observed. Illustrations of oscilloscope patterns are shown in Fig. 5. Installation of the pick-up on the cylinder head, as in Fig. 6, involves drilling and tapping a hole part way into the head but not into the combustion chamber. This device picks up vibrations in the cylinder head, not pressures within the combustion chamber. Some development has been directed toward providing other means of attaching the pick-up unit to the cylinder head, eliminating the necessity of drilling the head itself. Test work has also been done with a few pick-up units, or even a single one, installed on the crankcase, but so far, at least, this does not allow individual investigation of each cylinder pattern.

The carburetor must be adapted to the widest possible range of manual leaning, with good control in very lean ranges to allow meticulous investigation of the mixture response curve in the vicinity of minimum boost point. Thermocouples should be installed in the intake pipes of those cylinders equipped with cylinder head temperature gages. This installation must be made so that the thermocouple is in about the middle of a cross section of the pipe and yet cannot "see" the intake valve.

Some method of controlling carburetor air temperature is necessary. This is usually adequately taken care of through normal hot air or alternate air controls. However, unless the characteristics of air flow through the induction system are thoroughly known, the carburetor air temperature gage should be supplemented by a simple grid of thermocouples just before the carburetor in such a manner that a temperature pattern of a cross-section of the incoming air can be obtained. Often an alternate air supply system will cause stratification of incoming air to an extent making intermediate positions of the controls unusable for test work.

A means of measuring air flow is desirable in preference to empirical curves correlating air flow with rpm. and manifold pressure, because the latter curves cannot take into account variations within the engine being tested. One method of achieving an air flow measuring device on the engine is to have carburetor and scoop air-boxed prior to installation to correlate air flow with the metering suction between two chambers of the carburetor. These chambers can then be hooked up to a gage in the cabin to measure the differential during tests.

A humidity measuring device is the last piece of required instrumentation. Accurate determination of the humidity in which the tests are being performed is necessary to be able to convert results to standard conditions. A simple psychrometer adapted to the open airstream is all that is needed.

Eliminating Variables

Other than the foregoing special instrumentation the engine should be as standard as possible to duplicate actual operating conditions. It is desirable to run tests on engines with nearly the maximum allowable time since overhaul, because variables which creep in with cylinder head deposit, irregular valve clearances, higher oil consumption past piston rings, and wide sparkplug gaps, make such engines more critical as regards detonation. To eliminate these variables in setting up close operating limits is not realistic. Often an engine which cannot be made to detonate in perfect condition will do so at surprisingly low power levels after 500–700 hr. Naturally, operating limits must be set to allow safe operation at all times, not just when the engine is new.

To obtain complete data, investigation of detonation at all power settings should be arranged in a reasonable order. Investigation should be made of climb, also cruising engine speeds. Rated and takeoff power investigations should be left to last because it is then that an engine is most heavily stressed.

Primary Setting

First setting to be investigated should be at climb power engine speeds. Although it is unlikely that full rich detonation will be encountered at these

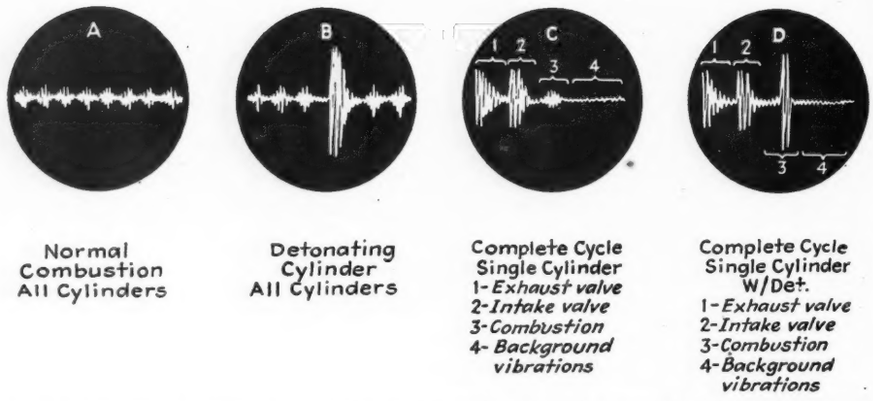


Fig. 5. Oscilloscope patterns, as picked up by detection apparatus, give clear interpretation of detonation within cylinders. Through these patterns, valuable records of tests are obtained for further study.

powers, it is very little trouble to have a quick try at the setting most likely to produce it, for the sake of complete data. Therefore, engine speed should be set at the proper value, mixture control in full rich, and throttle opened slowly until either detonation or full throttle is reached.

If the latter condition is reached without detonation, which may well be the case, full rich detonation for this setting and for lower power settings may be eliminated from further consideration. The engine is unable to "stress" the fuel on the extreme rich end of the mixture response curve at this engine speed. This might correspond to point M on Fig. 1.

With throttle still wide open, mixture should be leaned extremely slowly until detonation is encountered. This procedure, bringing the engine across the fuel-air ratio range at a constant manifold pressure equal to that at which maximum power at that rpm. can be obtained, is similar to leaning-out action depicted along line A-B in Fig. 1. It is necessary that leaning be done with care so that equilibrium temperatures can be maintained for the infinite number of points making up the constant manifold pressure line. If the fuel-air ratio gets ahead of temperature conditions, a misleading result will be obtained—a result which will not be representative of actual operating conditions. When a predetermined level of detonation indication is encountered on the oscilloscope or the flashing neon light, all readings should be taken and the mixture control moved toward full rich until detonation disappears. A check run should then be made on the point just taken.

After the first point is thus established, mixture should be richened, manifold pressure reduced 2 in., and another detonation point established in a similar manner. This is repeated until it is impossible to encounter detonation by leaning all the way to engine cut out. The sloping portion of the mixture response curve (between B and C on Fig. 1) has by this time been fairly well defined. The last constant manifold pressure run might have been equivalent to the 28-in. line of Fig. 2.

Finding Minimum Boost

One of the most important points—point E, the minimum boost point—must now be established. After richening up again from point D, manifold pressure is set at ½ in. below that at which detonation was last encountered and mixture is leaned to detonation, establishing another point. This reduction of manifold pressure in ½-in. steps is continued until a detonation free level is again encountered and minimum boost point has been defined.

Often, actual definition of the curve at minimum boost point is very difficult when using the procedure of sweeping the fuel-air ratio range at a constant manifold pressure as just described, since the manifold pressure lines become tangent to the mixture response curve and the actual point has will-o-the-wisp tendencies. In these cases it is best to define the approximate fuel flow at which the minimum boost point would fall by sweeping into and through the detonation area (as at C-R on Fig. 1) close to minimum boost point.

Having established this fuel flow, manifold pressure should be lowered several inches and fuel flow set at the desired value. Fuel flow is held at this value while slowly increasing manifold pressure until detonation is encountered. A cleaner definition may thus be made, since the detonation limit line is being approached at approximately right angles, as illustrated in line F-G of Fig. 1.

This procedure is repeated at engine speeds equivalent to high speed cruise, normal cruise, and long-range cruise operations. If it is found that a minimum boost point can just be established at full throttle at one engine speed, an engine speed of about 100 rpm. less will probably not be sufficient to produce detonation under any conditions, and no investigation is necessary at any lower engine speeds. If detonation can be encountered at all engine speeds under consideration, the investigation should be made at approximately 100-rpm. intervals until either no detonation can be produced, or an engine speed below that which is feasible to use in operation is reached. Cross fairing of results will fill in the intermediate points between the 100-rpm. steps.

Next power level to be investigated should be rated power at rated speeds. Since no engine made by a major manufacturer at the present time should continuously operate at rated power at a fuel-air ratio leaner than, or even as lean as, .075, it is necessary only to investigate the rich end of the mixture response curve. Therefore, engine speed should be set at the prescribed value, mixture control in full rich, and throttle slowly opened to full or to detonation. Then readings should be taken. Mixture should then be leaned at constant manifold pressure until detonation is again encountered. If the second point was at a fuel-air ratio of .075 or leaner, the run is complete. If not, mixture should be richened and manifold pressure reduced 1 or 2 in. as the fuel-air ratio at the last point indicates, and mixture should again be leaned to detonation or a fuel-air ratio of .075. Rarely will it be necessary to make runs at more than two manifold pressure settings.

Final Power Setting

Last power level investigated will normally be takeoff power. The method should be approximately the same as that used in defining the rich end of rated power setting curve. If no detonation is reached at full-throttle full-rich, that particular fuel-engine combination does not exhibit the phenomenon of full rich detonation and the rest of the investigation can proceed to find out lean detonation characteristics. If no detonation is encountered at a fuel-air ratio of .075 at full throttle, takeoff power detonation run is complete. Leaning-out beyond this ratio would needlessly endanger the engine and accumulate no valuable data, since .075 fuel-air ratio is leaner than best power mixtures and does not allow for fuel cooling, which is still considered a necessary practice.

In all of the foregoing, for simplicity, we have passed over the procedure which determines the rich side of the high power hook if one of the original checks in this area results in detonation. Suppose that in full-rich position detonation were encountered before full throttle has been reached. After taking readings,

the mixture should be leaned out until detonation has disappeared, and then richened to within approximately 20 lb./hr. fuel flow of that flow at which detonation was encountered. Manifold pressure is then increased to either full throttle or until detonation is encountered. At each of the manifold pressures at which detonation occurs on the rich end of the rich power hook, the mixture is leaned out to detonation or to a fuel-air ratio of approximately .075.

This procedure is repeated until full throttle is reached at no detonation or until a manifold pressure is reached at which rich and lean detonation points are practically coincident. This method has, in effect, resulted in the saw-toothed dotted paths, AKB, illustrated in Fig. 1, to define the rich hook on the curve. The procedure outlined above allows a right-angle approach to the curve in this area, because here again, as at minimum boost point, manifold pressure lines may become tangent to the curve.

To evaluate the change in detonation-limited operating characteristics with a change in carburetor air temperature, it is advisable to repeat all runs in full hot and full cold carburetor air control positions, or, if stratification does not exist in the air-scoop, at least in two temperature sets with approximately 75 deg. F. difference. Conditions might best be those which cover the range of operations encountered, particularly high temperature conditions, since these are most conducive to detonation. Linear effect of air temperature can then be developed and results of tests extrapolated to cover all normal operating conditions. In general, increasing carburetor air temperature on the mixture response curve lowers the power level at any given engine speed at which detonation will result. The effect is most pronounced on the lean portion of the curve and somewhat less so on the rich portion.

Since detonation is definitely influenced by carburetor air temperature, detonation tests should be performed with outside air temperature of at least 30 deg. C. so that adequate stressing of the engine fuel combination will be achieved. Further, a high ambient temperature has the effect of eliminating volatility effects which, if present, would confuse results.

Tests should be performed at the lowest feasible altitude so that maximum manifold pressures may be obtained. Check points may be made at higher altitudes to assure that altitude effects do not change results. In any event, when data are being taken, the pilot should be instructed to hold as close as feasible to the altitude determined for the tests, and on any one run to hold airspeed within fairly constant values to maintain an even flow of cooling air over the engine. Otherwise tests results will show an undesirable scatter in data points.

If the engine is equipped with more than one stage or speed of supercharging, tests should be re-run in each blower position in those ranges where specific blower position might be used.

Visual Observations

It is highly desirable to supplement observations taken on test equipment with observations of the exhaust stacks in flight. In some aircraft, these stacks are easily visible from the astrodome. In such cases the astrodome should be equipped with interphones so that the observer can keep in touch with the pilot and test engineer. As light detonation is encountered, intermittent wisps of fine black smoke will be seen, and as detonation becomes heavier smoke puffs will become more distinct. Smoke indications of detonation, when reported by an experienced observer, correspond closely to indications on the oscilloscope.

The observer thus becomes a valuable check on the equipment, both for substantiating data points and as a safeguard in case the equipment malfunctions.

If at all possible, data should be plotted as they are recorded. A running plot is valuable to the test engineer as a constant indication of how the picture is shaping up, and plans may may be modified on the spot to speed up the test or to recheck wild points.

With data which are the result of the testing outlined in this article, the operator is in a position to compare his existing operation within the margin-of-safety limitations imposed upon it. Within these limitations, a realistic, economical operation can be set up.

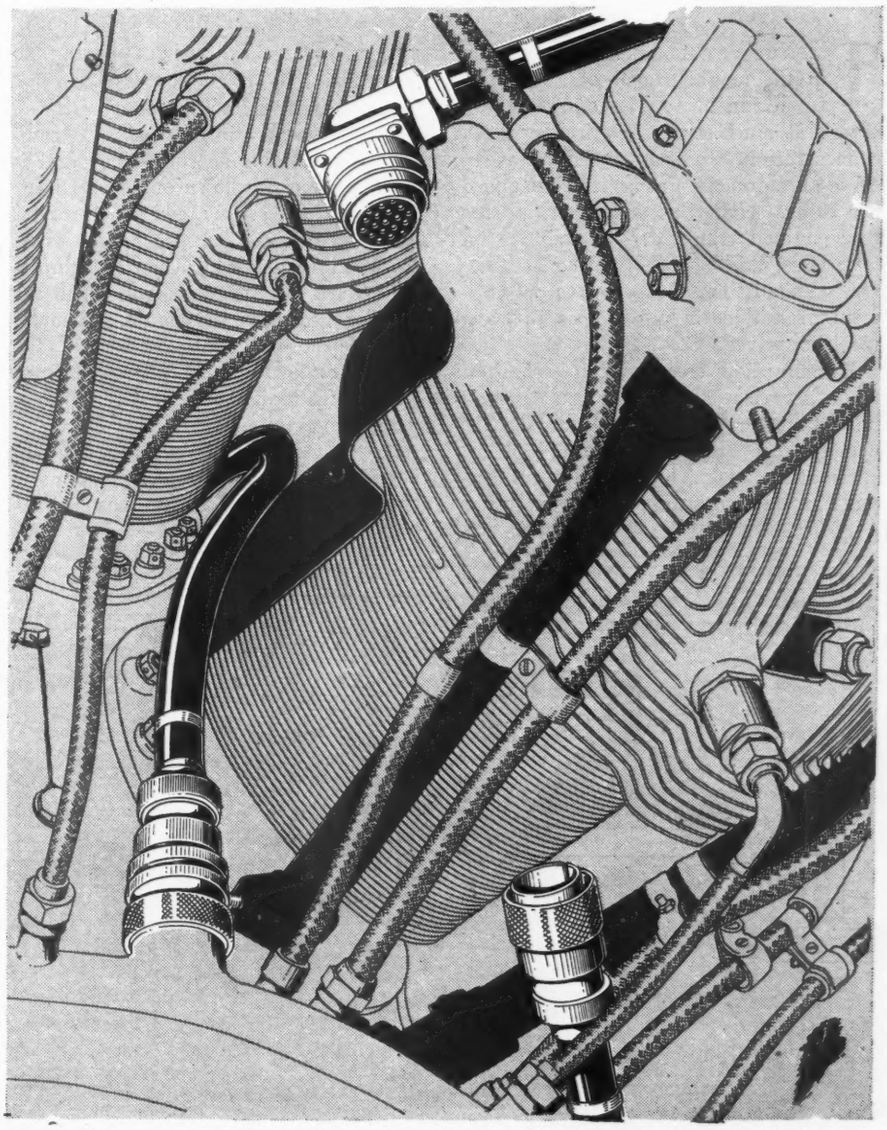


Fig. 6. Pick-up units fitted on radial engine, showing parts of harness, disconnected plug, and receptacle. Installation calls for drilling and tapping a hole only partway into head.

Wider Operating Scope Attained by New Automatic Pilot

By **RAYMOND N. GREIF,** *C. M. Johnson Co., Grumman Aircraft Engineering Corp.*

First engineering details of Grumman GR-1 unit reveal ability to perform jobs hitherto outside "George's" range. In fact, new robot not only adds utility but also saves both weight and space.

TO PILOT A SMALL AIRPLANE, traveling in the neighborhood of 350 mph., for a run of two hours, sometimes entails as much strain, requires as much concentration, and is as tiring, as to drive an automobile at an average speed for 10 hr. And when dealing with large four-engined transports or bombers on long runs, this task of piloting becomes really exhausting. But with the development of automatic pilots, this problem has been solved.

Human pilots frequently are called on to do a variety of things related to and important for the flight but actually independent of it. With the aid of an automatic pilot, the human pilot can concentrate on avigation, radio, and other exacting problems, without having to worry about flying the airplane.

A new-type automatic pilot—GR-1—has been recently introduced by Grumman Aircraft Engineering Corp. and is being successfully flown on several leading Army and Navy combat aircraft. This pilot differs from others in several important respects. Rushed to completion toward the end of the war to fill the need for a lightweight, simple, automatic flight device for fighting aircraft, the new automatic pilot in its present form is readily adaptable for use on peacetime commercial aircraft.

The unit is a self-synchronous, maneuvering automatic pilot. Automatic synchronization is a continuous adjustment relative to the position of the airplane, assuring continuation of the plane's flight attitude at the moment of engagement of the automatic pilot. Thus, the tedious necessity of adjusting knobs or setting dials before engaging the automatic flight equipment—which is necessary on prevalent types—has been completely eliminated. On standard automatic pilots, unless adjustments as to position and attitude of the plane are made by the human pilot at the moment of engagement, turning the equipment "on" will cause the plane to jolt into straight and level flight regardless of the previous position of the airplane. In any event, should the operator forget to make these adjustments, a none-to-pleasant result may be expected, a factor to which an operator who has experienced this forgetfulness will attest.

With the new-type pilot, such a condition is totally impossible. Regardless of the position and attitude of the airplane or the absentmindedness of the human pilot, when the automatic pilot is engaged it will instantaneously and auto-

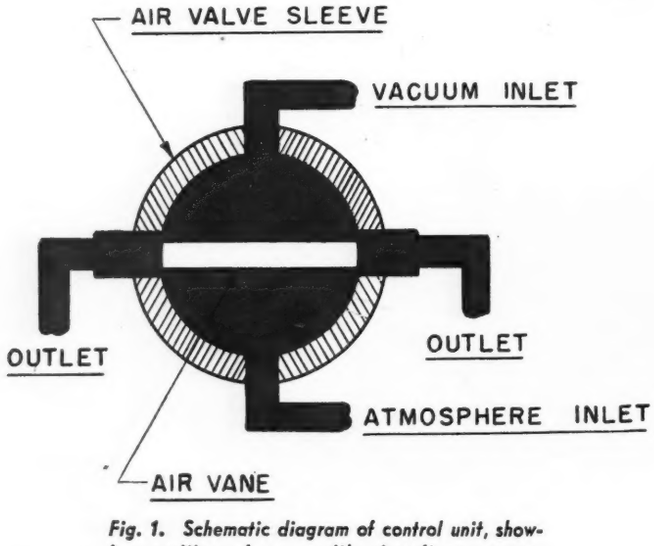


Fig. 1. Schematic diagram of control unit, showing position of vane with aircraft on course.

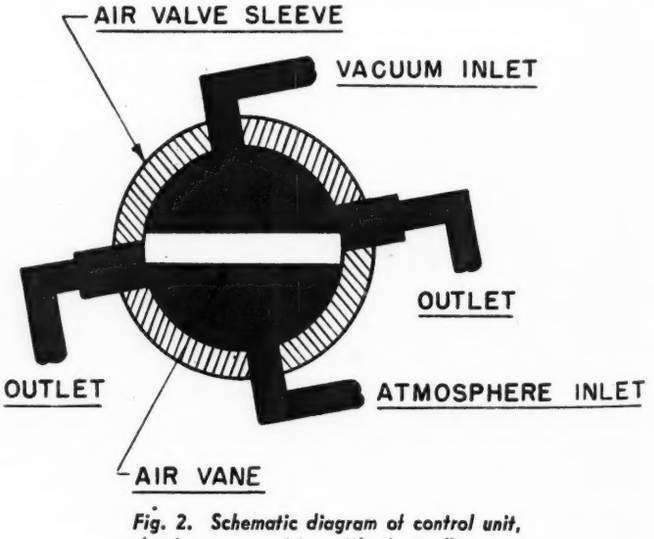


Fig. 2. Schematic diagram of control unit, showing vane position with plane off course.

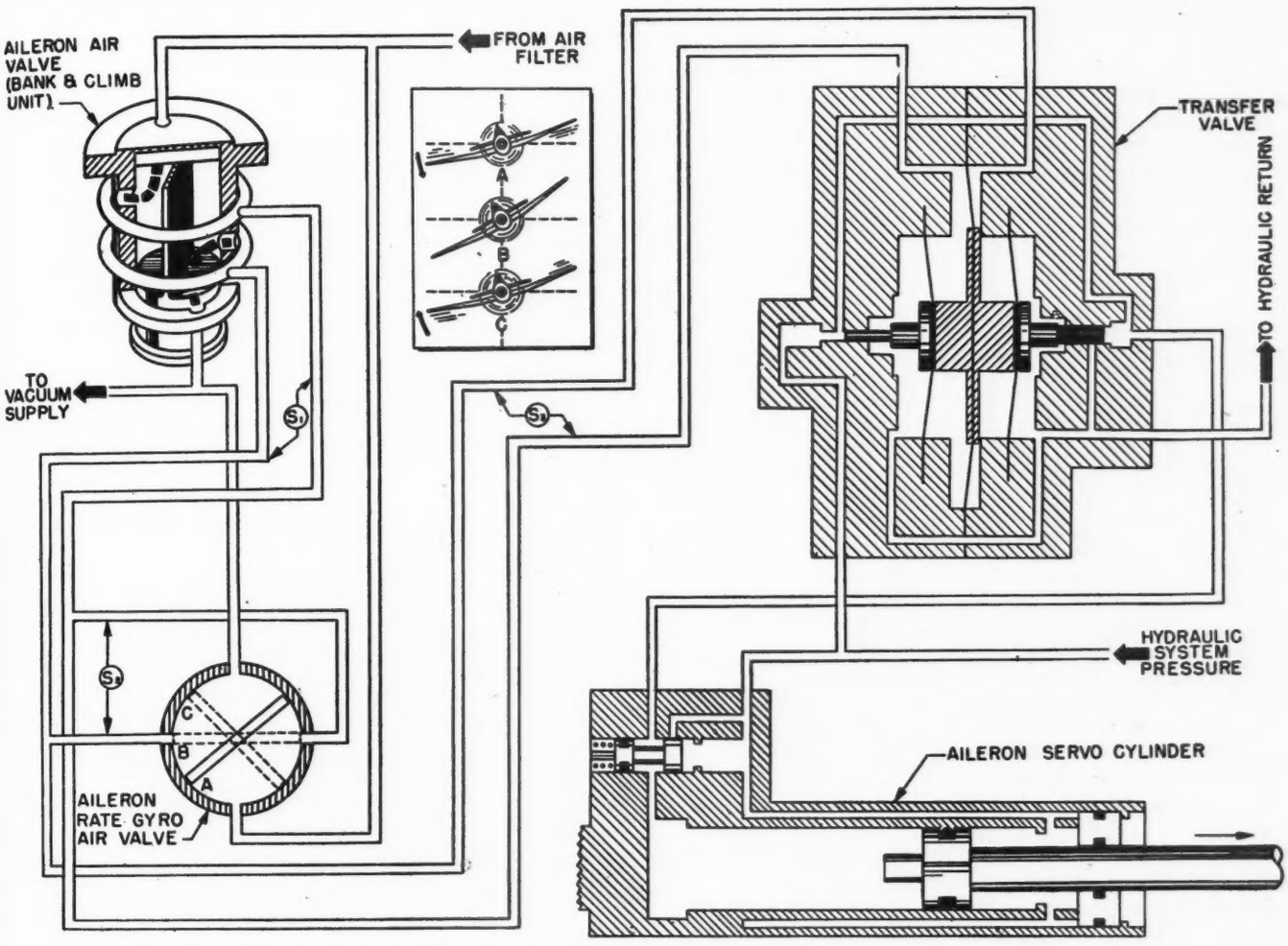


Fig. 3. In this layout drawing of the Grumman GR-1 automatic pilot method of operation with aircraft's right wing down is illustrated.

matically "take over" and continue flying the airplane in its existing flight attitude —i.e., if in a climbing turn, the airplane will continue to climb and turn to exactly the same degree as the moment previous when under human control. The manifold advantages and values of this feature should be obvious to both designers and pilots alike.

Maneuvering an airplane equipped with this automatic pilot is a simple matter. Dives, climbs, banks, coordinated turns, and climbing and diving turns may be accomplished while on automatic flight by simple finger-tip operation of a small control lever. This lever, less than 1½ in. high, is operated, in general, in a manner similar to the operation of a conventional airplane control stick to achieve the desired results. The limits of all maneuvers are controlled by the operating limits of the automatic pilot, these being: Dive, 50 deg.; climb, 30 deg.; and bank, 45 deg.

Another important advantage of the new pilot is its light weight. The entire assembly, consisting of eight individual components, weighs approximately 27 lb. Interconnecting tubing, wiring, and fittings increase the weight slightly; however, the complete installation still remains less than one-third the weight of conventional pilots.

There are only two cockpit control devices for flying an airplane equipped with this unit—an on-off control handle, and a controller. As its name indicates, the control handle is used to engage and disengage the automatic pilot. At all times when the handle, and therefore the automatic pilot, is in the "off" position, with the airplane battery supply turned "on", the synchronizing system is operative. In other words, whenever the automatic pilot is not in operation, its synchronizing system is functioning, thereby insuring automatic adjustment of the attitude of the airplane in the event the control handle is turned "on".

The control handle has a third position which is resorted to in cases of extreme emergency. In the event of "blacking out" or injury to the human pilot, by pulling the handle to this third position the airplane will automatically centralize, i.e., return to straight and level flight and remain there until the operator recovers sufficiently to take control.

The other cockpit device is the controller, with which straight and level flight may be maintained, or maneuvers executed. The control lever, as described above, is used for automatic maneuvering flight. A button, which is mounted on the lever, is depressed when it is desired to maintain a specific directional heading with the directional gyro control.

Basically, the automatic pilot is similar to other units in that its operation depends upon the gyroscopic principle of rigidity. As is well known, a gyroscope is a universally-mounted fast-spinning wheel which tends to maintain its spin axis rigidly in space regardless of the movements of the supporting body. This

property is utilized to establish a reliable flight reference, within the airplane, from which deviations from any desired attitude are detected and corrected. Detection is accomplished by an electric-pneumatic system, and corrections are made by a hydraulic system.

There are five gyroscopes used in the GR-1: Two displacement gyros and three rate gyros. One displacement gyro is located in the directional gyro control unit and the other is located in the bank and climb control unit; while the three rate gyros are located in the stabilizing unit. The displacement gyros are sensitive to the amount of deviation, and the rate gyros are sensitive to the rate of deviation. The indications of the gyros are utilized through a pneumatic-hydraulic system to obtain corrective movements of the airplane controls.

Five Operating Conditions

The automatic pilot is operable under five separate conditions, as follows:

1. Automatic pilot "off"—synchronizing. With the airplane in flight and the on-off control handle in the "off" position, the synchronizing system is operative. This is the equivalent of continuous automatic adjustment and it assures continuation of flight attitude existing at the moment the automatic pilot is engaged.

2. Automatic pilot "on"—stabilized flight without direction control. At the moment of pulling the on-off control handle to "on" position, the synchronizing system ceases for the bank and climb gyro control units. The effect is to cause the aircraft to continue in whatever flight attitude it was in, i.e., if in a climbing turn, it will continue to climb and turn. This allows the operator complete freedom in engaging the automatic pilot,

Grumman GR-1 automatic pilot units. Upper left, directional gyro control unit; upper right, stabilizing unit; lower left, relay box; and lower right, bank and climb control unit.

since no trimming or adjustments for position are necessary.

3. Automatic pilot "on"—stabilized flight with direction control. With the automatic pilot "on", direction control can be established at any time by depressing the straight-course button. This causes the synchronizing system to cease for the directional gyro control, and the plane will maintain the course it was on at the moment of the depressing of the button.

4. Automatic pilot "on"—maneuvering control. With the on-off control handle in the "on" position, the plane can be maneuvered by manipulation of the control lever in the cockpit.

5. Automatic pilot "centralized"—centralizing control. With the on-off control handle held in the "full-out" or "centralized" position, the plane will automatically return to level flight from any attitude within the limits of the gyroscopes.

The directional gyro control unit contains the gyro which provides a reference for both manual and automatic rudder control. The air-driven gyro rotor rotates with its spin axis horizontal. Due to gyroscopic inertia, the spin axis continues to point in the same direction, even though the aircraft yaws. This relative motion between the gyro and the instrument case is shown on the face of the instrument by a dial, similar to a compass card. The dial, when set to agree with the magnetic compass, provides an azimuth indication that is free from swing.

In construction, the directional gyro control unit utilizes a standard directional gyro indicator with necessary modifications so that the unit is capable of measuring yaw deviations in terms of an air signal. Referring to the schematic diagram shown in Fig. 1, the control unit contains an air vane (A) which is mounted directly on the vertical gimbal ring of the gyro, and an air valve sleeve (B) into which fits the vane. Since the vane is mounted on the gyro gimbal ring, it will always remain stationary as long as the gyro is spinning.

The sleeve, which contains four ports set 90 deg. apart, is mounted to the instrument case and is free to rotate about the vane as the airplane deviates from its course.

One of inlet ports is open to the atmosphere, the other being connected to the vacuum supply. Both outlet ports lead indirectly to the transfer valve which controls rudder movement. When the vane is in the neutral position—that is, airplane on course as shown in Fig. 1—equal signals are impressed upon both outlet ports, resulting in zero pressure differential. When the sleeve is rotated—airplane off course as shown in Fig. 2—an unbalance is set up causing a pressure differential across the outlet ports. This differential is directed into the transfer valve, which causes a correction to be made, thus bringing the airplane back on course and returning the signal to zero.

The directional gyro control unit also contains a small electric motor which can operate to drive the air valve sleeve in either direction during synchronization.

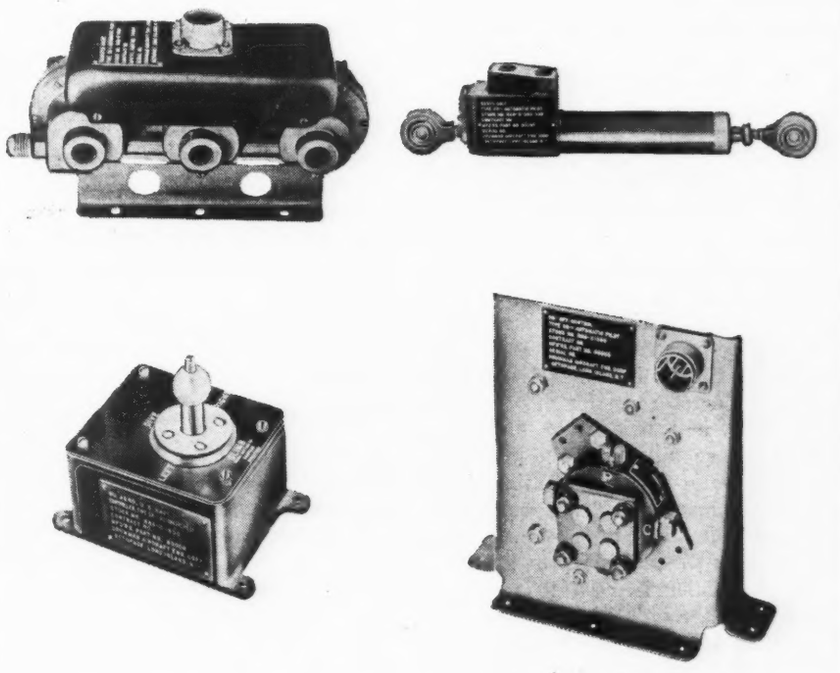
Bank-and-climb gyro control unit component is a gyro providing a reference for both manual and automatic aileron and elevator control. The air-driven gyro rotor rotates with its spin axis vertical. Due to gyroscopic inertia, the spin axis continues to point in the same direction, even though the aircraft rolls or pitches. Any relative motion between the gyro and the instrument case is shown on the face of the instrument by either the tilt of the bar or raising or lowering of it, relative to the miniature airplane. The position of the miniature airplane can be raised or lowered in relation to the horizon bar by the adjusting knob in order to compensate for various load conditions of the airplane.

The bank-and-climb gyro control unit consists of applicable portions of a standard gyro horizon indicator and, in addition, contains two air valves similar in construction and operation to the one in the directional gyro control unit. The air valves measure the deviations in bank and pitch and transmit air signals to the transfer valves. Also, the bank-and-climb control unit contains two small electric motors which function during synchronization.

Before the air signals from the bank-and-climb and directional gyro control units reach the transfer valves, they pass through the stabilizing unit. The primary function of the stabilizing unit is to prevent hunting and to control the rate of change of attitude. The anti-hunt mechanism consists basically of three rate gyros sensitive to rotation about each of the three axes. Each gyro controls a separate air valve which is connected in parallel with its respective signal given by the directional gyro control and the bank-and-climb control.

How Anti-Hunt Works

To explain a typical anti-hunt action, the elevator rate gyro air valve assembly may be considered. The gyro rotor revolves with its axis parallel to the longitudinal axis of the airplane and with its gimbal ring axis vertical. Rotation of the airplane about its lateral axis—i.e., climb or glide—will cause the gyro to precess. As the gyro moves, a shaft mounted on the gyro turns with it. This motion is transmitted through linkage to the vane of an air valve. This air valve is similar to those in the bank-and-climb and directional gyro control units,



Control units of Grumman automatic pilot. Upper left, transfer valve assembly; upper right, servo cylinder; lower left, controller; and lower right, on-off control.

except that the vane, and not the valve, is free to rotate.

As the vane rotates, a differential air signal is superimposed upon the signal coming from the elevator air valve in the bank-and-climb control unit. During the initial stage of any deviation from level flight, the rate gyro air valve signal is additive to the signal from the bank-and-climb unit, but when the corrective elevator has stopped the deviation and the plane starts to return to course, the rate gyro precesses in the opposite direction and the rate gyro air value signal is subtractive from the bank-and-climb control signal. If the rate of return is fast, the rate gyro signal will be large, thus proportionally reducing (by cancellation) the bank-and-climb control signal, thereby stopping the maneuver before overshooting.

The stabilizing unit also controls the synchronizing mechanism which insures zero signal, within pilot operating limits, at the moment of engaging the pilot. The synchronizing mechanism consists basically of three diaphragms controlling three pick-off motors geared to the rotating sleeves around the rudder, elevator, and aileron air valves in the directional gyro and bank and climb control units. The synchronizing diaphragm consists of two air chambers separated by a flexible membrane. Each chamber is connected in parallel with the two air signal lines from each of the three air valves.

Device Always "Ready"

Whenever the plane deviates from a given attitude, even though the automatic pilot is "off", air signals are transmitted by the gyro control units. However, since the automatic pilot is "off", no automatic correction will take place. Instead, the unbalanced condition will cause the synchronizing membrane to deflect to the right or left, thus closing electric switches which run the pick-off motors clockwise or counterclockwise so as to bring the signal back to the zero, or balanced, condition. These electrical circuits are operative whenever the automatic pilot control handle is in the "off" position. Therefore, as long as the automatic pilot is "off" during flight, the pick-off sleeve will always be in a position to give a zero differential signal and, at the moment of engagement, the automatic pilot will take over in whatever attitude the plane may be flying.

The controller is used to maneuver the airplane through the automatic pilot. The small control lever duplicates the control features of the conventional airplane control stick and rudder pedals. Movement of the lever produces, within limits of the automatic pilot, the same results obtained by similar movement of the airplane control stick, except for physical "feel."

Each movement of the lever closes different electrical switches which control the pick-off motors in the bank-and-climb control units and the "coordinated turn" valve in the stabilizing unit. For instance, if it is desired to dive the airplane, the control lever is pushed forward. This closes a switch which controls the elevator pick-off motor in the bank-and-climb unit. The pick-off motor turns the elevator valve sleeve thereby causing a differential signal to be set up. This signal calls for corresponding elevator control which actuates the airplane to a valve position of zero signal, which in this case is the new position of the valve sleeve—that is, the dive position. When the correct amount of dive is obtained, the control lever is released and the airplane continues in the existing dive attitude.

In a similar manner, a climb is achieved by pulling the lever aft, a left coordinated turn by pushing it to the left, and a right coordinated turn by pushing to the right. Climbing and diving turns are accomplished by pushing the lever forward or backward and at the same time giving it the desired sidewise movement.

A tiny button on the lever is used to engage the course-holding function of the automatic pilot, i.e., to maintain the airplane on a particular directional heading. Depressing the button disconnects the synchronizing mechanism of the directional gyro control and permits directional gyro air signals to be directly connected to the transfer valve. Therefore, whenever the button is depressed, corrective rudder, keeping the airplane on course, will be in effect. By the same token, if it is desired to bank the aircraft and still maintain direction (bank without turn), the lever is moved to the desired sidewise position, but at the same time the button must be depressed.

The on-off control is used to engage and disengage the automatic pilot. The assembly consists of the handle, a hydraulic selector valve, and two electric switches of the normally-open circuit type. When the control is in the "off" position, one of the switches keeps the synchronization system in operation. When the handle is pulled to the "on" position, synchronization ceases for the elevator and aileron controls and the automatic pilot takes over. (As previously discussed, synchronization does not cease for the rudder control until the button on the controller lever is depressed.) For emergency use the on-off control is provided with a third position. When the handle is pulled to this full-out or "centralized" position, electrical circuits are energized and the airplane automatically returns to level flight from any previous attitude.

Function of the transfer valves assembly is to transform the differential air signals from the gyro units into a corresponding hydraulic pressure, which is transmitted to the servo cylinders that receive the hydraulic pressure signals from the transfer valve assembly and produce the corrective movement for the airplane control surface. There are three identical units, one for each control surface. Their operation is similar to a typical double-acting hydraulic actuating cylinder, a force being transmitted to the controlling surface on both the inward and outward strokes of the piston.

Action Exemplified

To explain a typical action of the automatic pilot, the aileron control of the bank and climb unit will be used. The rudder and elevator controls are operated in a similar manner.

For the illustrative example, the following condition has been chosen arbitrarily: Control handle in "on" position, automatic pilot on stabilized flight with directional control. As shown in Fig. 3, the airplane is being displaced in roll so that one wing is lower than the other. The rotation of the airplane about its longitudinal axis produces a pair of differential air signals S_1 which are conducted into the stabilizing unit where an aileron rate gyro air valve is connected in parallel with them. (The rate gyro responds to the rate of maneuver and regulates the maneuver.)

As the plane is being displaced (inset illustration of airplane, view A), the vane in the rate gyro is deflected to position A so that it produces a pair of differential air signals, S_2, proportional to the rate of displacement. The air signals S_2 from the rate gyro, therefore, are additive to the air signals S_1 from the control unit and produce the maximum corrective aileron. At the moment that this correction brings the roll to a halt (inset illustration, view B), the vane in the rate gyro returns to a neutral position (position B). As the wing starts to return to level position (inset illustration, view C), the vane assumes the position C so that the differential air signals governed by the rate gyro will be subtractive from the control unit air signals and may exceed them, giving reverse control or zero air signal at the moment preceding the attainment of level position. This eliminates hunting.

The combined differential signals S_3 then pass to the transfer valve where they produce movement of the diaphragm assembly with resultant movement of the servo piston causing corrective aileron.

STRAIN ANALYSIS QUICKLY FINDS FORMABILITY LIMITS*

PART I

By **GEORGE GERARD**, *Senior Research Engineer, Republic Aviation Corp.*

How basic elongation data can be used in conjunction with a geometrical analysis to expedite the prediction of formability limits of a part . . . First article in a revealing two-part design series.

WHEN DUCTILE 17S and 24S were used almost exclusively in aircraft structures, cold forming was accomplished in the annealed or O temper. However, as the industry began to recognize the advantages of forming 24S in the T or heat-treated condition, and accordingly adopted the latter, forming became much more difficult because of limited ductility in this temper. As a result, investigations were started in fundamentals of formability, to ascertain elongation characteristics of the materials and the state of strain in various forming operations.[1]

Coupled with these fundamental strain investigations have been elongation surveys on formed parts by the photo-grid method,[1] which have yielded information whereby correlation with elongation data on tensile coupons has been attempted. An example is the correlation that Lockheed obtained between elongation in a ¼-in. gage length on a tensile coupon and minimum bend radius.[1]

Second fundamental in formability research has been theroetical analyses based on geometry of formed parts.[1, 2] These analyses have been useful in indicating formability limits, but except for the author's article on minimum bend radii,[2] no published analysis has, to our knowledge, used the basic material elongation data established from tensile coupons.

Strain analysis of the formed part, together with basic elongation data, is an excellent method for predicting formability limits and has been successfully applied in solving the basic formability problem of minimum bend radii in various width of bends.

Method Detailed

To obtain the basic elongation characteristics of a metal, a photogrid is printed on the reduced section of a tensile coupon. Reduction of strain distribution data obtained from the tensile coupon strain-gage establishes the empirical factor which must be known to establish formability limits.

To obtain completely the elongation characteristics of a material bi-axial stress which arises in the reduced portion of a standard tensile coupon must be considered. If no stress existed in the direction normal to the applied stress—simple tension—the ratio of lateral to normal elongation would be 0.5, Poisson's ratio in the plastic range. Tests indicated some restraint in the lateral direction, as shown by the mean lateral contraction of 0.35 of the strain in the direction of applied load (see Fig. 1). No such restraint was noted in the thickness direction.

Existence of this bi-axial tensile state reduces the ultimate strain values, and therefore the strain-gage length curves must be corrected to simple tension. The correction is derived from Fig. 2, in the following manner:

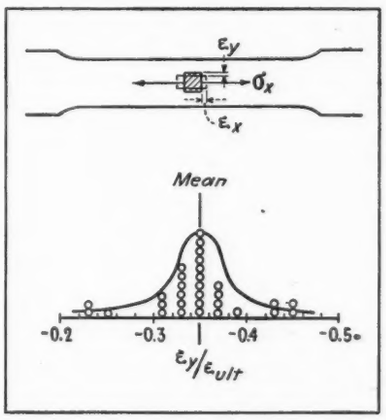


Fig. 1. Ratio of lateral to axial strain in tensile coupons. Materials: A1-24ST, A1-75ST, and R301T.

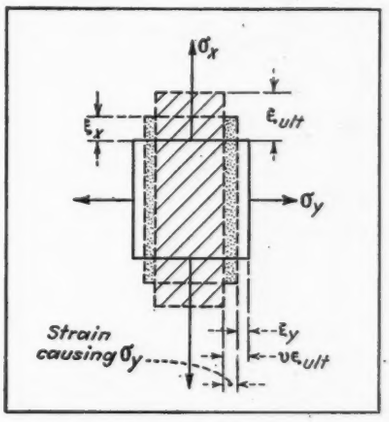


Fig. 2. State of strain in a wide bend and also in a tensile coupon.

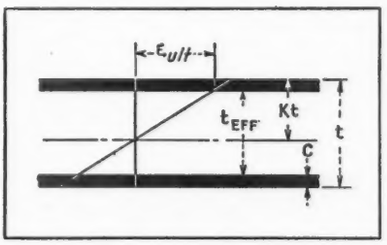


Fig. 3. Parameters for bends of clad material.

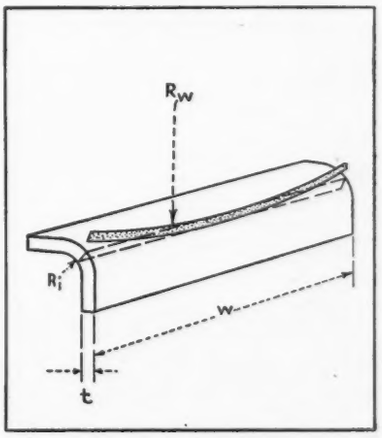


Fig. 4. Anticlastic curvature of bend if no restraint were imposed in width direction.

* Based on paper presented before Society for Experimental Stress Analysis.

[1] (References are collated at the end of this article)

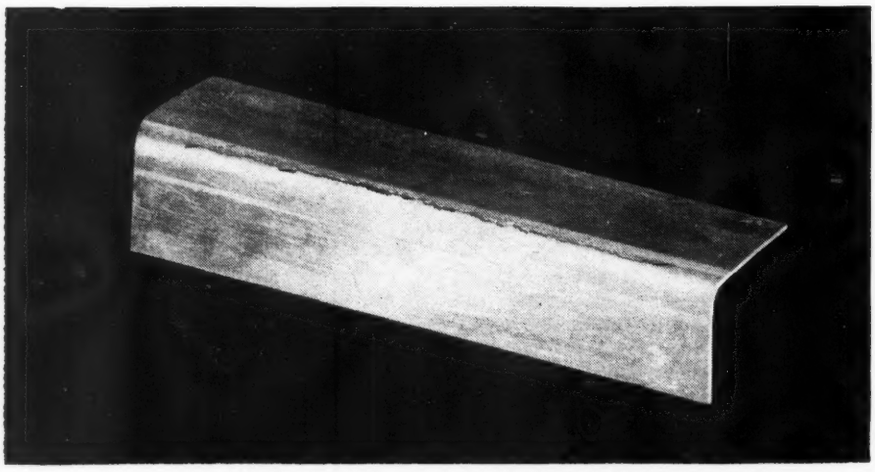


Fig. 5. Characteristics cracking of center of bend width, caused by bi-axial stress condition. Material is R-301T, 5/32 thick and 10 in. long.

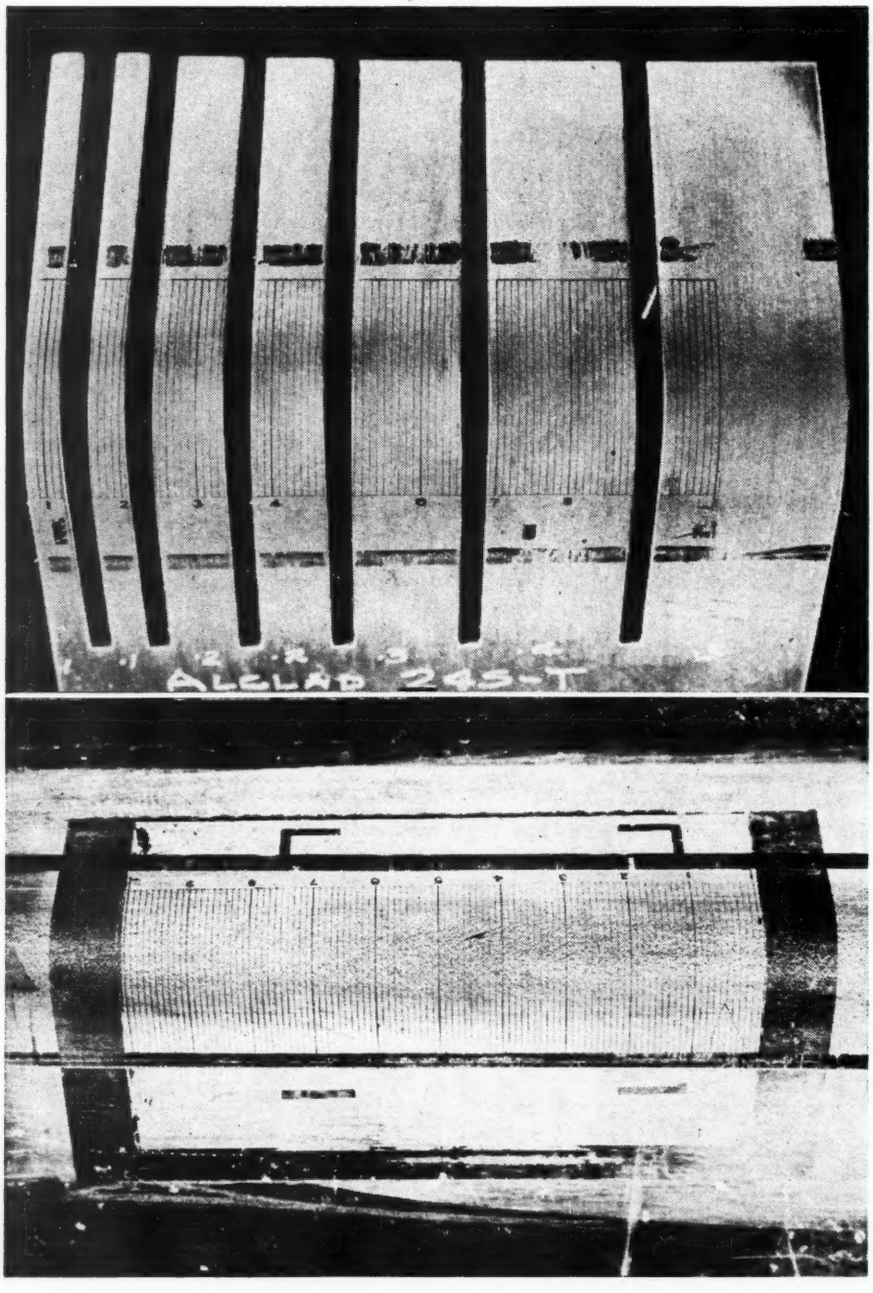


Fig. 6. Photogrids of narrow (top) and wide (above) specimens.

$$\epsilon_x = \epsilon_{ult} - \nu\,[\epsilon_y - (-\nu\epsilon_{ult})]$$

where: ϵ = strain, in./in.

ϵ_{ult} = Strain under simple tension, in./in.

ν = Poisson's ratio = 0.5 in the plastic range.

The strain under simple tension

$$\epsilon_{ult} = \frac{\epsilon_x + \nu\,\epsilon_y}{1 - \nu^2} \qquad (1)$$

To determine the ratio $\epsilon_y/\epsilon_{ult}$, and since $\nu = 0.5$

$$\frac{\epsilon_y}{\epsilon_{ult}} = \frac{0.75\,\epsilon_y}{\epsilon_x + 0.5\,\epsilon_y} \qquad (2)$$

Bend Analysis

The strain conditions existing in an idealized narrow bend have been described.[3] From the geometric analysis of a minimum value of bend radius, the ultimate strain

$$\epsilon_{ult} = \frac{K}{R/t} \qquad (3)$$

where K is the ratio of the distance between the neutral axis and the outside fiber to the total thickness. This ultimate strain is attained in a bend gage length of

$$L = R\,\Theta \qquad (4)$$

where R is the neutral axis bend radius and θ is the bend angle in radians.

For Alclad, correction for the cladding thickness is required. Cladding material is a low yield strength alloy capable of sustaining much larger ultimate strains than the base metal. Consequently, it will fracture underneath the cladding, as shown in Fig. 3. The effective sheet thickness subjected to the ultimate strain is less than the actual sheet gage,

$$t_{eff} = (1 - 2c)t \qquad (5)$$

Therefore, for clad sheet, Eq. 3 becomes

$$\epsilon_{ult} = \frac{K}{R/t}\,(1 - 2c) \qquad (6)$$

However, letting $\epsilon_{ult_c} = \dfrac{\epsilon_{ult}}{1 - 2c}$ results in

$$\epsilon_{ult_c} = \frac{K}{R/t} \qquad (7)$$

Hence, Eq. 7 is identical in form to Eq. 3, except that the strain value is corrected for the cladding thickness.

The above analysis assumes that the outside fiber is subjected only to simple tension stresses. This condition has been found to be true for widths of less than 0.1 in. A bi-axial tensile stress condition similar to that shown in Fig. 2 arises in bends of greater width because anticlastic curvature of the bend is inhibited.

In the bending process, tension and compression loads are applied to the outside and inside surfaces, respectively. These forming loads induce strains, by Poisson's effect (in the width y and

thickness z directions), having a magnitude equal to one-half the applied strain. The z direction strain is not restricted by the geometry of the formed part, consequently some thinning can occur in the bending process. Actual reduction in thickness is insignificant.

The strain in the width direction, however, is affected by the bend geometry. The outer fiber strain induces a lateral contraction in the width direction, similarly the inner fiber strain induces a lateral elongation, and unless the bend curves in the width direction (as shown the Fig. 4) these induced strains will be checked. The geometry of a wide bend ($w = > 0.1$ in.) completely checks this anticlastic curvature because of the relatively large moment of inertia of the flange and the high degree of curvature of the material in the bend region.

Except for a highly localized curvature at the edge of large bend widths, the center of the width is straight, and consequently the width direction strain must be zero. Therefore it can be concluded that the induced stress along the bend width arises from the restriction upon lateral strain.

At the center of the tension side of the bend, there exists a bi-axial tension condition which is highly unfavorable and which reduces the formability of the material. The bi-axial stress state is reduced to a simple tension at the edge, where the anticlastic curvature is not restrained, and consequently cracking may be confined only to the central region of the bend width where lowest elongation exists. A typical example is shown in Fig. 5.

To investigate the actual magnitude of the bend width effect and to ascertain the variation of this effect with width, a photo-grid strain analysis was conducted on Alclad 24ST, Alclad 75ST, and R-301T bend specimens of various widths. The grids were placed along the bend width (as shown in Fig. 6) so as to measure the y-direction strain. In each case, the x-direction strain was determined by using Eq. 3.

Results of this investigation are shown in Fig. 7, where the ratio of width strain to bend strain, $\epsilon_y/\epsilon_{ult}$ is plotted as a function of width. From these data, the empirical relationship,

$$\epsilon_y/\epsilon_{ult} = -0.02\, w^{-5/4} \qquad (8)$$

was established.

The strain in the y-direction which induces a lateral stress is the difference between the lateral contraction arising by Poisson's effect and the actual strain, as is illustrated in Fig. 2. This stress in turn tends to produce a contraction in the x-direction so that the maximum tensile strain which can be attained is reduced to

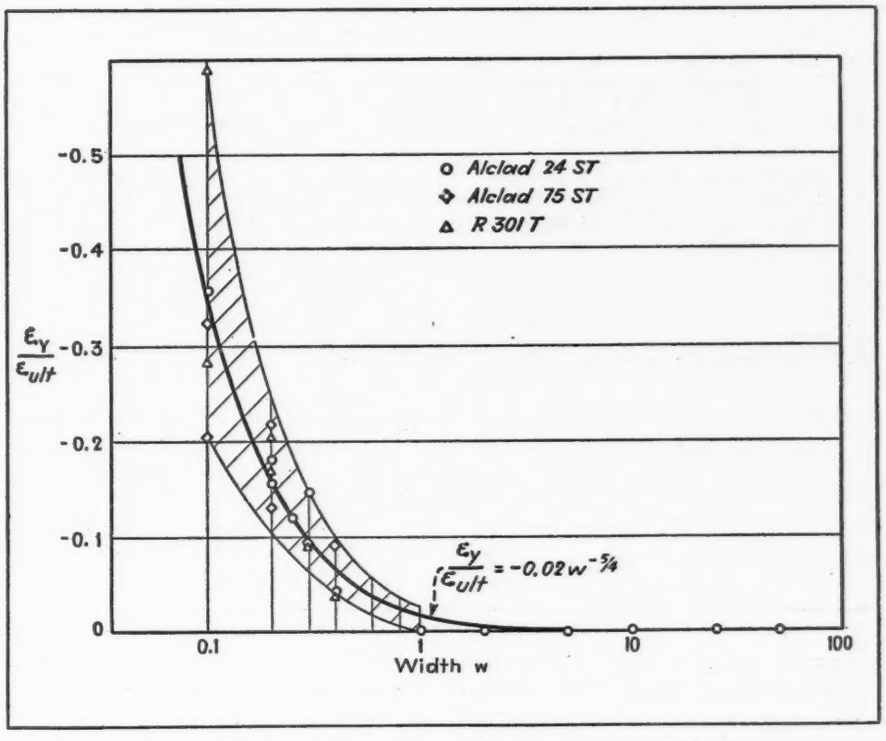


Fig. 7. Graph showing variations with width of ratio of strain in width direction to strain in bend direction in simple tension.

$$\epsilon_z = \epsilon_{ult} - \upsilon\,[\epsilon_y - (-\upsilon\,\epsilon_{ult})],$$

simplifying

$$\epsilon_z = \epsilon_{ult}\,(1 - \upsilon^2) - \upsilon\,\epsilon_y \qquad (9)$$

Empirical variation of $\epsilon_y/\epsilon_{ult}$ width width (Eq. 8) is now introduced, and hence,

$$\epsilon_z = \epsilon_{ult}\,(1 - \upsilon^2) + \upsilon\,\epsilon_{ult}\,(0.02\, w^{-5/4})$$
$$\epsilon_z = \epsilon_{ult}\,[1 - \upsilon\,(\upsilon - 0.02\, w^{-5/4})] \qquad (10)$$

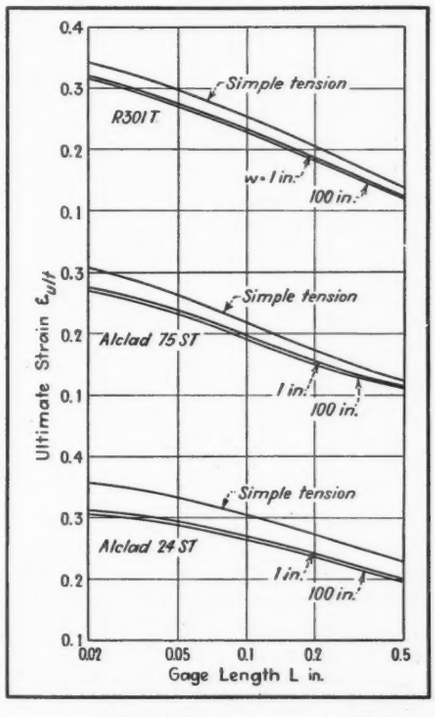


Fig. 8. The basic strain-gage length curves corrected to various widths.

The material elongation characteristics (the strain-gage length curves) can now be modified by Eq. 10 to account for the effect of the bend width. For a given width, w, this equation reduces to the form

$$\epsilon_z = \epsilon_{ult}\,(1 - K)$$

where k is a constant for each width. Thus the basic strain-gage length curve derived from tensile coupons can be corrected for the width effect, and the corrected curve can be used in solving for the minimum bend radius. Basic strain-gage length curves are shown in Fig. 8.

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2. Jackman, K. R., "Super-Aluminum Alloys for Aircraft Structures", Aug., Sept., and Oct. 1943 AVIATION.
3. Gerard, G., "Determining Bend Radius —Via Analytical Approach", Mar. 1945 AVIATION.

Symbols

e	elongation, in.
c	ratio of cladding thickness per face to total thickness
f	depth of joggle, in.
K	ratio of distance between outside fiber of bend and neutral axis to total thickness
L	gage length, in.
R	bend radius to neutral axis, in.
R_i	inside bend radius, in.
S	length of joggle, in.
t	thickness, in.
w	bend width, in.
x	coordinate in direction of bend
y	coordinate in width direction
z	coordinate in thickness direction
ϵ	strain, in./in.
ϵ_{ult}	strain in bend direction under simple tension, i.e., plane stress, in./in.
ϵ_{ult}, ϵ_{ult}	corrected for cladding thickness
θ	angle of bend, deg.
ψ	stress
υ	Poisson's ratio, 0.5 in plastic range

PEACETIME COST ESTIMATING REQUIRES NEW LEARNING CURVES

By **GARDNER W. CARR,** *McDonnell Aircraft Corp.*

Demonstrating how present costs cannot be logically related to wartime figures—which can only be misleading under today's conditions—this experienced costs engineer weighs the varying factors which must be considered as our industry enters a new era of keen commercial competition.

WITH THE ENDING OF WAR PRODUCTION, it is timely to take inventory of the cost experience gained during the past four years—especially to evaluate it for future use.

During the period just passed, big production was the outstanding objective, costs being of secondary importance. But now quantities produced in our field will be far smaller, and costs will be paramount.

Much cost data, gathered during the hostilities, are today misleading and hazardous as we contemplate postwar markets. The reasons are well worth examining:

1. Quantity—regardless of cost—created practices and mental attitudes dangerous to survival in a highly competitive field.

2. Attainment of high production, unlimited tooling, and mechanization—now expensive luxuries—certainly paid in results, but caused inflexibility.

3. Engineering costs rose because war pressure meant neophyte aircraft engineers could not be given really close supervision by trained overseers. Consequently, much estimating data were either done over or prematurely released, to be followed by expensive changes. Lack of skilled shop personnel required engineering data to be in much greater detail than in prewar days.

4. During early stages, shop costs were abnormally high. Tooling had to be

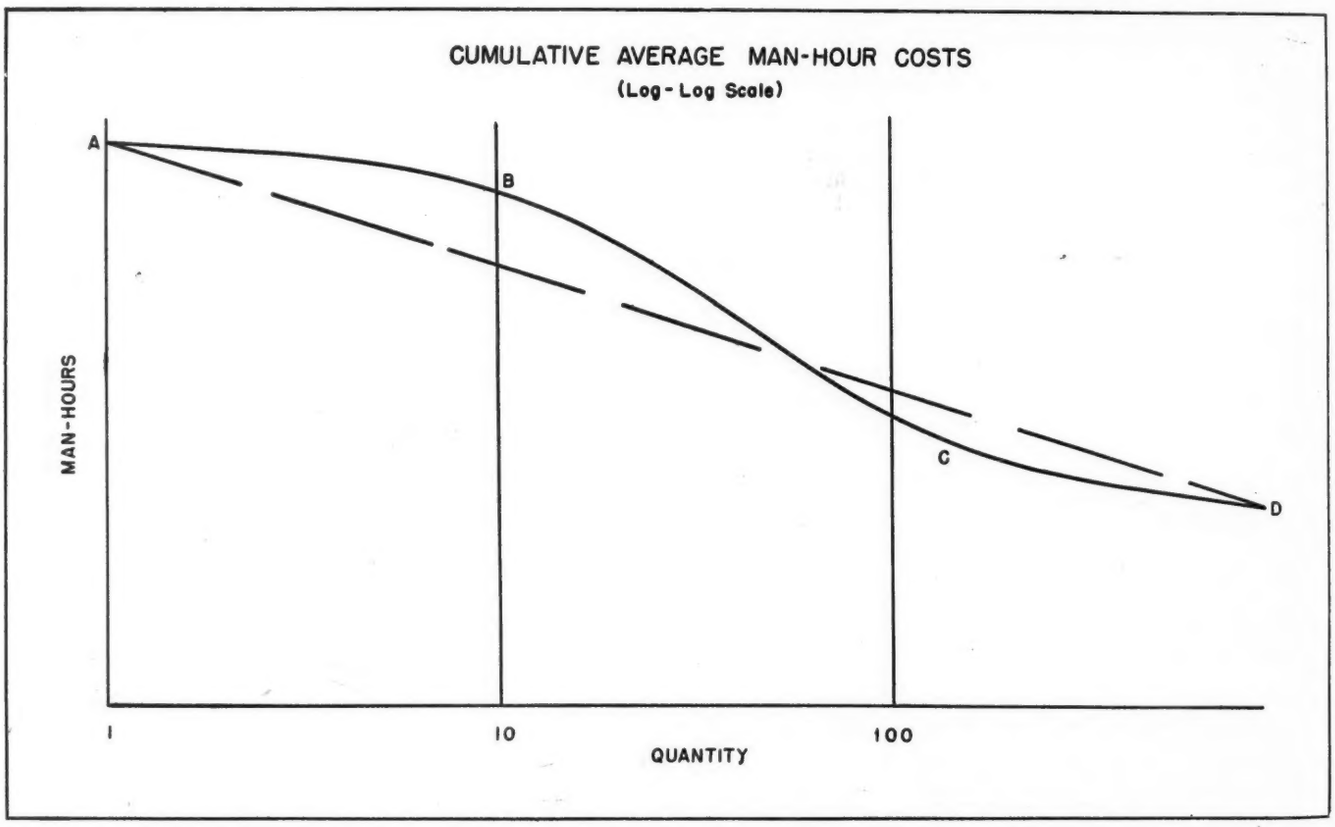


Chart showing average man-hour costs. (A) represents 1st unit, (B) normally falls between 10th and 20th units, (C) occurs between 100th and 300th units, depending on complexity of the product, and (D) is last unit. Slope and length of (A-B) are dependent on rate of acceleration and multiple tooling. Slope and length of (B-C) depend upon extent of tooling, breakdown of the airplane into accessible production subassemblies, and quantity built before "flat" is reached. Characteristics of (C-D) depend on quantity built after "flat" is reached, assuming no major changes in tooling or production techniques. Slope (A-D) may be used for overall project statistics but is rarely correct for budget or actual cost-finding purposes. Beyond (D), man-hour costs slowly approach optimum.

Unit and Cumulative Average Man-Hours — Effect of Multiple Crews

Unit No.	Unit Man Hours				Crew No. 1			Four Crews		
	Crew 1	Crew 2	Crew 3	Crew 4	Total Hr.	Total Units	Cum. Av.	Total Hr.	Total Units	Cum. Av.
1	100				100	1	100	100	1	100
2	60	100			160	2	80	260	3	8.67
3	50.6	60	100		210.6	3	70.2	470.6	6	78.4
4	45.4	50.6	60	100	256	4	64	726.6	10	72.7
5	41.8	45.4	50.6	60	297.8	5	59.6	924.4	14	66.0
6	39.2	41.8	45.4	50.6	337	6	56.2	1,101.4	18	61.2
7	37.1	39.2	41.8	45.4	374.1	7	53.4	1,264.9	22	57.5
8	35.5	37.1	39.2	41.8	409.6	8	51.2	1,418.5	26	54.6
9	34.0	35.5	37.1	39.2	443.6	9	49.3	1,564.3	30	52.1
10	32.9	34.0	35.5	37.1	476.5	10	47.6	1,703.8	34	50.1

This table shows that accelerations requiring multiple crews will raise average costs and may not result in straight-line ratios, although a single crew may follow the straight line on a log-log chart of cumulative man-hours. Also revealed here is reason why, when quantities are increased, addition of more personnel for concurrent delivery of spare parts results in higher, rather than lower, unit costs.

proved and corrected before production could flow smoothly. Experienced aircraft mechanics were not available, and inexperienced help required training, even though these operators, once taught, became highly proficient and their "learning curve" was very steep.

Obviously, then, there can be no sound basis for cost comparison between the foregoing conditions and the period ahead, where competition will be keen, volume comparatively small, tooling limited, and individual skill a dominant factor.

Comparison between prewar and wartime costs is enlightening. In the early '30s it was found that man-hour-per-pound cost curves were highest in fighter types and successively lower in observation and attack planes, followed next by bombers, and transports were lowest. Studies showed an almost identical slope for each of these types—about 80%—the data being applicable until just before the war. However, a new factor was appearing, namely high speed, which required refinements involving greater costs.

War production man-hour costs per pound of airframe show the following average learning-curve percentages:

Army fighters	73
Light bombers	69
Medium bombers	60
Heavy bombers	71
Transports	73
All prewar types	80

These curves cover only those models in high production. All curves would probably be less steep if aircraft produced in smaller quantities were included.

All curves are steeper than prewar standards because of the abnormal cost of getting into high production quickly, also because unlimited tooling and mechanization produced airplanes at phenomenally low man-hour costs, once high production was attained. Unfortunately, no reports have been published showing total costs of both production and tooling. Here, therefore we are unable to check war experience against previous concepts of tooling cost ratios.

With war costs distorted by so many factors, we must go back to fundamentals for postwar predictions. It is accepted that costs are governed by the following considerations: Aircraft type or performance; quantity; rate of delivery; and special conditions.

Considering first the aircraft type. War production did not modify the fact that high performance means high cost. The Lockheed P-38 introduced a new factor in cost calculation—that of "density", or lb. per cu. ft. A high density factor in an airplane is accompanied by inaccessibility or slow assembly and increased costs.

Quantity automatically determines type and extent of engineering and tooling programs.

Rate of delivery is probably the most important factor. Quick acceleration means multiple tooling and multiple crews, each with its own learning curve. The appended table gives a simple comparison if an assembly operation is performed by one or four crews, on the basis that crews are added or split as soon as one crew has finished one assembly. It is here assumed that all crews have the same efficiency.

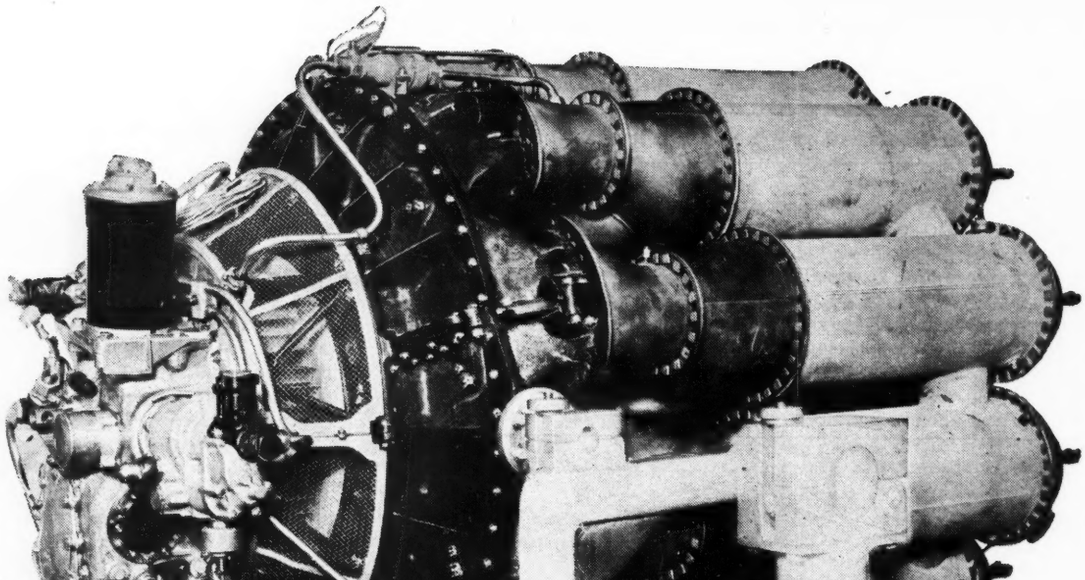
Without re-design or additional tooling, there is a definite limit below which operations cannot be performed at reduced man-hours. On fabrication, this limit is reached at an early stage, being governed by the speed of machinery and not by individual skill. On assembly, accessibility may establish the minimum hours possible. With all operations, a "flat" is reached sooner or later, beyond which only neglegible improvement may be expected.

There are also out-of-the-ordinary conditions which are not to be overlooked—such items as special flight instrumentation, sometimes very costly when an extended test program is required. Special equipment may involve many man-hours of installation time at much higher than usual man-hour-per-pound rates. These allowances include accessories not appearing in the airframe weight, such as auxiliary fuel tanks, special tools, handling gear, etc.

Another special consideration is the policy of the manufacturer with regard to engineering and tooling. With a preponderant investment in engineering, detail drawings, and design analysis, shop costs will be lower, while under a heavy tooling program, either man-hours can be reduced or lower-priced labor employed. During the '30s, two competing manufacturers followed opposite policies, one using high-priced labor with high man-hours and a low tool budget, while the other expended large amounts for tooling and had a labor-production rate 20% below that of his competitor—yet overall costs in the two plants were almost identical.

Learning curves are too often expressed as straight-line ratios on log-log charts. The accompanying diagram is thought to reflect more accurately the costs likely to occur on any project involving more than 100 airplanes, where a prototype has been previously built.

Learning curves can rarely be expressed by straight lines on log-log charts, for these curves are individual to each type of airplane and each manufacturer. Only sound basis of final-cost comparison is found in dollars per airplane, or per pound of airframe weight —*not* in man-hours of shop work.



First of Rolls Royce "River" class turbojets was Welland. Directly developed from original Whittle concept, this was a reverse-flow centrifugal-compressor single-stage turbine unit.

Comprehensive Chronology Of British Turbojet Developments

By JOHN FOSTER, JR., *Managing Editor, "Aviation"*

Just-released information on late English turbine-engine types permits presentation of revealing design details, together with genealogy clarifying lines of growth in both centrifugal and axial flow units.

WHILE THE GREAT MAJORITY of British turbojet engines have been centrifugal compressor types, stemming from Air Commodore Frank Whittle's original research, the first English studies were made on axial flow compressors.

Current declassification of turbojet information abroad only now reveals this and other facts, making it possible to clearly trace developments and present design and structural details of Britain's more modern types.

Just 20 yr. ago, Dr. A. A. Griffiths, then head of the Royal Aeronautical Establishment's engine department, presented studies of an aerodynamic theory for a turbine designed for a flow past airfoils rather than through passages. Experimental work along axial flow lines was continued by the RAE along with British manufacturers, including Metropolitan-Vickers, Armstrong Siddeley, and C. A. Parsons' organization, up to and through the war.

However, success of the Whittle unit brought concentration on the centrifugal type, as is shown by a brief resume of a rather complicated genealogy resulting from cooperation between the government and several industrial concerns.

Whittle's first engine, the W.1, was designed by the company specially set up for that purpose—Power Jets, Ltd.—with the unit being built by the British-Thomson Houston Co., which also built the successor, W.2. Then, in Apr. 1940, the Ministry of Aircraft Production decreed that Power Jets should concentrate on research and development, and it accordingly turned the W.2 drawings over to the Rover Co. for production.

The British-Thomson Houston unit, modified by Power Jets, became the W.2 Mark IV; while modifications by the Rover Co. resulted in the W2B, from which was derived the "River" class en-

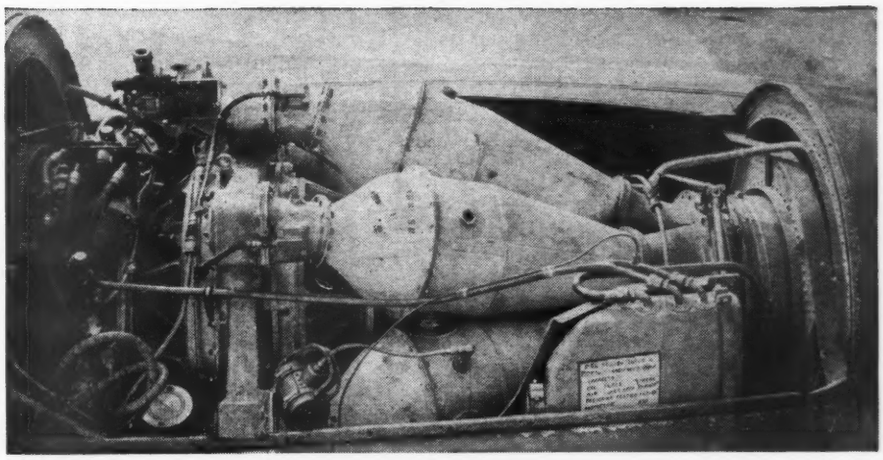
gines produced by Rolls Royce and also the I-A, first produced in this country by the General Electric Co. as sire of its I-16 series.

Rolls Royce interest in the turbojet field dates back to 1938, when Dr. Griffiths joined its staff, and by 1941 test units had been put in action to study various components. Meanwhile the company's production facilities had been made available to both Power Jets and Rover, and parts of the W2B were made for the latter.

First of the Rolls Royce River class engines, designed in collaboration with Power Jets and based on the Whittle conception, was the Welland, which reached the test stage in late 1942. A centrifugal compressor unit with ten reverse flow combustion chambers, it had static sea level thrust of 1,700 lb. and a weight of 850 lb. Passing its 100-hr. test in Apr. 1943, the Welland went into production in May 1944 as the power plant of both prototype and first production models of the twin engine Gloster Meteor, which was used against Nazi V-1 buzzbombs.

Meanwhile, Rover engineers had done preliminary work on a throughflow design, but this type of unit did not find favor with Power Jets because it required a longer shaft between compressor and turbine, calling for installation of a third bearing. However, Rolls Royce—which in Apr. 1943 took over Rover development work—went ahead with the prototype, known as the W2B.26 and it first ran in May 1942.

This unit, first of the Derwent series, had a thrust of 2,000 lb. at 16,500 rpm. and a dry weight of 850 lb. Utilizing a two-sided impeller and ten combustion chambers, the engine had an overall diameter of 42½ in. and length 101½ in.



Closeup of Rolls Royce Trent installation in a Gloster Meteor. Basically a Derwent engine fitted with reduction gear driving conventional propeller, Trent is strictly an experimental unit.

This unit was followed by Derwent Marks II, III, IV, and V—the latter being described in detail, together with the record-breaking Gloster Meteor, in AVIATION for January (Page 69). The Derwent I and IV each gave a 10% increase in thrust; the III was an experimental installation set up for boundary layer control studies.

Though basically of the same design, the V has an increased-capacity centrifugal compressor and nine instead of ten combustion chambers. Fuel control, too, differs. On the I, pump capacity was fixed and flow to the combustion chambers controlled by by-passing excess fuel. On the Derwent V, pump capacity is varied by means of an aneroid to reduce fuel supply at altitude.

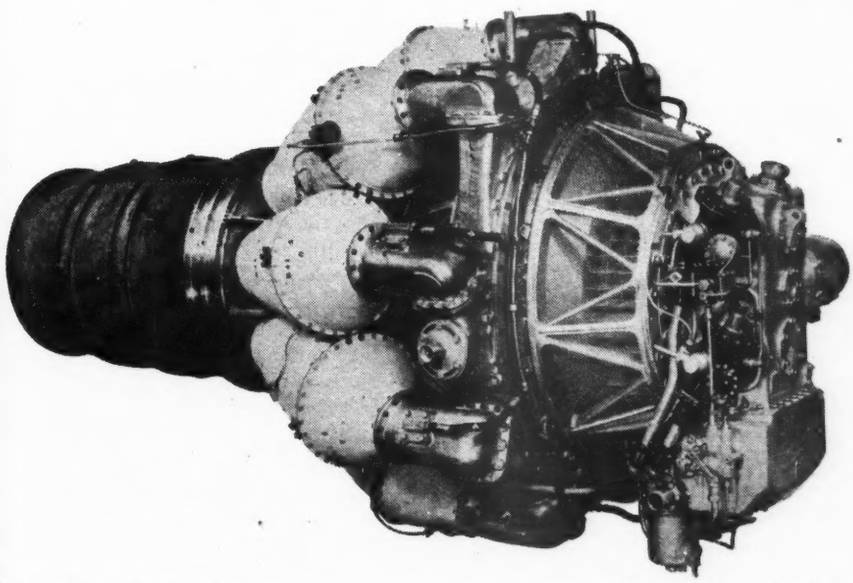
Another change on the V is that the discharge nozzle box at the rear of the combustion chamber is a casting rather than a fabricated structure, a change made to eliminate splitting and cracking of welding due to the high temperatures. And securing of nozzle vanes inside the nozzle box has been improved by using a buttress type connection, which reduces differential expansion of vanes and casings. Another important difference is in the bearings, the V using roller instead of plain bearings.

By May 1944, Rolls Royce had developed a reduction gear which was installed on a Derwent engine for driving a propeller, this unit finishing test stand runs in Mar. 1945 and beginning flight tests in the Gloster Meteor in September of that year—the first British turbine-driven propeller engine to fly. This power plant, known as the Trent, is strictly an experimental unit built to study propjet problems. Its total weight is approximately 1,500 lb., 250 lb. each for the propeller and reduction gears and 1,000 for the engine itself.

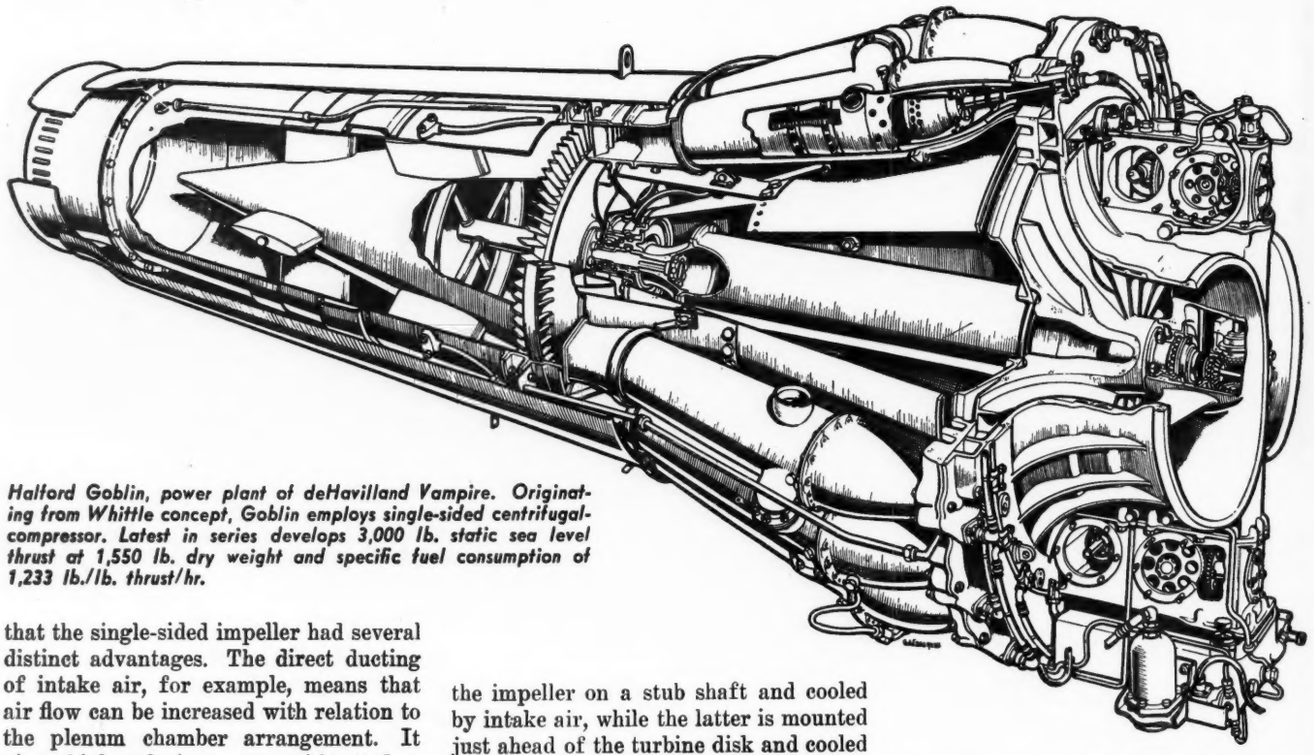
Latest of the Rolls Royce River class engines is the W2B.41 (B/41), called Nene, on which details have not yet been released. Geometrically very similar to the Derwent V, it develops static sea level thrust of 5,000 lb. at 12,400 rpm. with a dry weight of 1,550 lb., and it has specific fuel consumption of 1.06 lb./lb. thrust/hr.

Growing out of the Whittle design, but developing with basic differences from it, have been the turbojets developed by Maj. Frank Halford and the deHavilland Company. It was in Jan. 1941 that Maj. Halford, who had developed the Gypsy and Napier reciprocating engines, was brought into the gas turbine power plant field. His organization worked closely with deHavilland interests and, in Mar. 1944, became, without personnel change, the deHavilland Engine Co., Ltd.

Main difference between the Halford and other British centrifugal engines lies in the fact that Halford engines—the Goblin I and II—use a single-sided impeller. Throughout the development program, the Halford interests have felt



Latest in Rolls Royce River class in Nene, a centrifugal-compressor throughflow unit developing 5,000 lb. thrust at weight of 1,550 lb. and specific fuel consumption of 1.06 lb./lb. thrust/hr.



Halford Goblin, power plant of deHavilland Vampire. Originating from Whittle concept, Goblin employs single-sided centrifugal-compressor. Latest in series develops 3,000 lb. static sea level thrust at 1,550 lb. dry weight and specific fuel consumption of 1,233 lb./lb. thrust/hr.

that the single-sided impeller had several distinct advantages. The direct ducting of intake air, for example, means that air flow can be increased with relation to the plenum chamber arrangement. It gives high velocity entry without flow breakaway, reduces pressure losses, takes quite full advantage of ram effect, and simplifies installation. While a two-sided impeller has a greater intake capacity for a given engine diameter, the need for getting air to the rear face means a larger overall installation diameter.

Design work was started in Apr. 1941, with the first H.1 reaching the test stage a year later, and flight test stage in Mar. 1943, when two were installed in an early Meteor type. First flights in the de-Havilland Vampire were made in Sept. 1943 and in the prototype Lockheed XP-80 in Jan. 1944. Its thrust was brought up to 3,000 lb. at 10,500 rpm., with a total weight of 1,550 lb. and specific fuel consumption of 1.233 lb./lb. thrust/hr.

In Goblin II, the 31-in.-dia. impeller with 17 vanes delivers air to the combustion chambers at a 3.3:1 pressure ratio at maximum speed of 10,200 rpm., giving vane tip speed of 1,430 fps. One of the main differences between the Series I and II engines is in the design of the labyrinth seal on the aft face of the impeller, which matches with grooves on the sealing plate. In the latest series, a semi-buttress shape is used, compared with full buttress on the earlier model. Clearance of the lips on a cold engine is .015 in., with expansion under heat during operation bringing an overlap of .075-.095 in.

Hollow rotor shaft, machined from a steel forging, is bolted to both impeller and turbine disk. The rotor assembly is supported on front and rear roller bearings, the former being mounted ahead of the impeller on a stub shaft and cooled by intake air, while the latter is mounted just ahead of the turbine disk and cooled by ducted air bled from the compressor between combustion chambers. No thrust bearing is required, since the single-sided impeller tends to pull forward, counteracting the pull aft of the turbine.

The single-stage turbine has 83 blades made of Nimonic 80, an alloy with a high nickel content. Blade roots are serrated "Christmas tree" type fitting into serrations on the turbine disk and held in place by peening the roots on both sides, the upstream peening being heavier to resist rearward thrust.

Goblin II has 16 flowerpot-type combustion chambers of three main elements: Outer casing, flame tube, and burner. The tapered cylindrical outer casing is deep drawn mild steel, protected inside and out by nickel plating, fastened by a flanged joint to a die-cast aluminum expansion chamber (at upstream end) which is bolted to the diffuser casing. The downstream end is attached to the turbine nozzle junction assembly by a piston-ring type expansion joint.

The flame tube is concentric with the outer casing, held in place by three pins attached to the outer casing but permitted to slide inside sockets for radial expansion. The burner comprises outer and inner cup-shaped caps and flared cover plate.

Approximately 20% of the air entering from the compressor flows through a metering annulus into the inner cap for primary combustion, some going through a swirler around the fuel nozzle, the remainder around the swirler to give turbulence to mix fuel and air. The remaining 80% of the air, as it passes through the annular space between the outer casing and flame tube, is brought into the flame tube through ports.

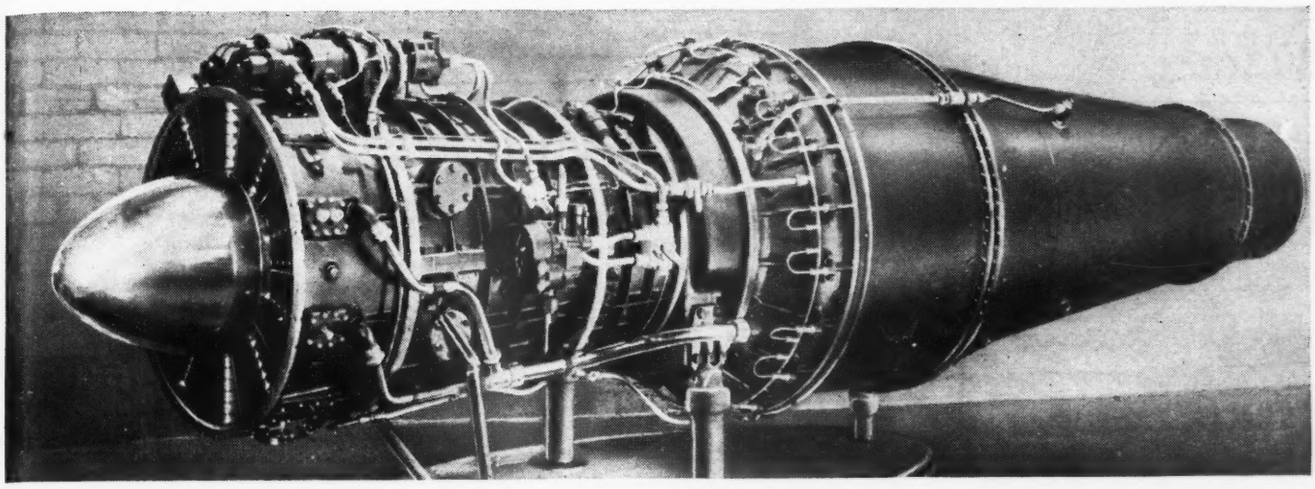
Combustion takes place in the forward third of the chamber, with the air being added serving to reduce temperatures from 2,000 deg. C. near the burner to not more than 790 at the turbine.

Another highly interesting British development is the Bristol Theseus, a project now in the experimental stage and on which little information is available. Designed for use on long-range medium-speed transport craft, the unit's propeller is driven by one of three turbines, and a heat exchanger, for heat regeneration from exhaust gases, is also used.

As reported by Dr. Harold Roxbee Cox, wartime chairman of the Jet Collaboration Committee, the Theseus comprises an axial-cum-circumferential compressor which delivers air through the heat exchanger to eight combustion chambers, then through three turbines, two of which drive the compressor and accessories, the third driving a conventional propeller through epicyclic reduction gear. In its present state of the unit's development, approximately 80% of the power is delivered to the propeller, the remaining 20% being used for jet.

All the units discussed, it will be noted, have been centrifugal compressor types growing out of the original Whittle design. But work on axial-flow types has not been entirely neglected in England since Dr. Griffiths' pioneer work.

For example, an REA 1938-designed 8-stage compressor known as Anne, was built in 1939 by Armstrong Siddeley and tested the following year.



Metropolitan Vickers F.2/4, first British axial-flow type to reach flight test stage. With 10-stage compressor and single-stage turbine, it delivers 3,500 lb. thrust at 1,700 lb. dry weight.

And in 1939 the Parsons organization built an 8-stage compressor called Alice.

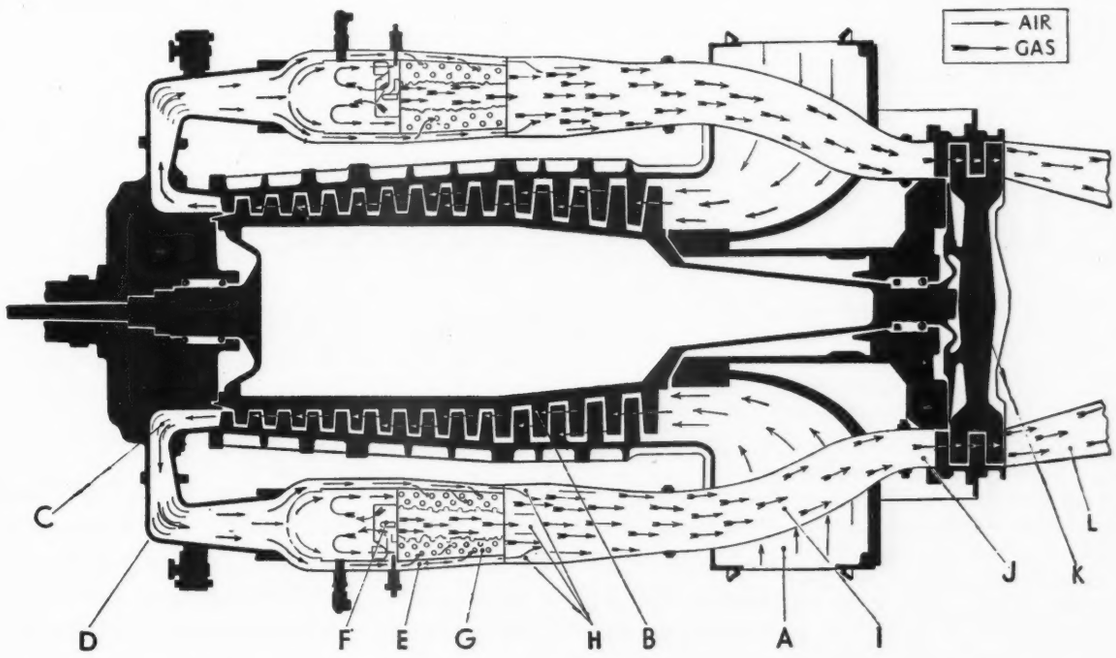
As a result of these and other studies, Metropolitan-Vickers in 1940 began construction of an axial flow propjet, designated the D.11 and designed for 2,000 bhp. This project was halted, however, to concentrate on an axial-flow turbojet, and in July, 1940, the company started design work on the F.2, a 9-stage axial-flow compressor annular-combustion chambered 2-stage turbine unit. Two of these engines were installed in a specially modified Gloster Meteor, and the first successful flight of a British axial-flow turbojet was made on Nov. 13, 1943.

Development on this project has continued to the point where the current unit, the F.2/4 with a 10-stage compressor and single stage turbine, delivers some 3,500 lb. static sealevel thrust for a dry weight of 1,700 lb. This thrust is about twice that of the original unit, but the weight and overall dimensions—42 in. dia. and 13 ft. 3-in. length—are very little more than those of the prototype.

In 1942, Armstrong Siddeley was given its first gas turbine contract, the results being the ASX and ASP, the latter essentially the ASX driving a propeller.

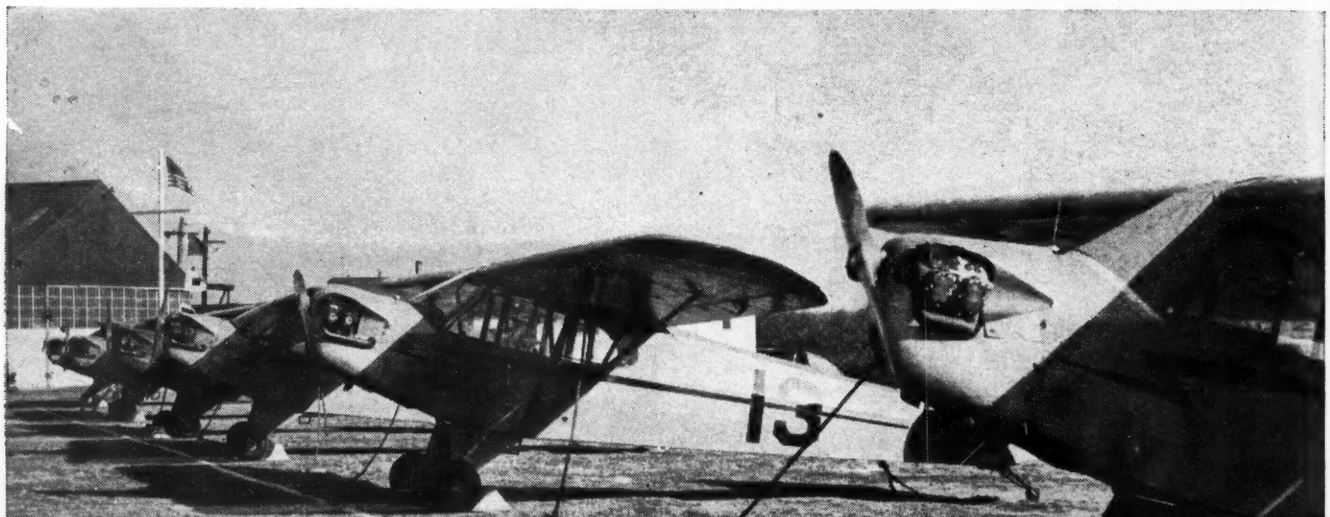
The ASX was running within nine months, according to company, delivering its calculated thrust of 2,550 lb. with specific fuel consumption of 1.0 lb./lb. thrust/hr. The prop-driving ASP delivers some 3,600 shp. and 1,100 lb. thrust.

This basic plant is a reverse flow axial unit, the air entering through ports about midway along the engine between the combustion chambers, turning 90 deg. into the 14-stage axial compressor, then turning 180 deg. into the eleven combustion chambers and on out through a two-stage turbine, as shown in the accompanying illustration.



Armstrong Siddeley reverse flow axial compressor turbojet. Intake air enters at ports (A) between eleven combustion chambers, then through 14-stage axial-flow compressor (B), final stage raising pressure to about five atmospheres. Air, which is then displaced outward by radial guide vanes (C), is divided into eleven parts and is directed into elbows (D) which incorporate guide vanes and lead into combustion chambers (E). Approximately 25% of air goes to inner chamber fitted wih mixing chamber (F), where paraffin fuel is injected. Remainder of air enters chambers through perforations (G) in rear half of inner chamber and in directional scoops (H). Burning gases then flow into manifold (I) and are re-formed at annulus (J) at entry to 2-stage turbine (K) before going through exhaust nozzle (L). Front main bearing—in addition to supporting main shaft carrying compressor and turbine—also takes thrust and is relieved of major part of load by cup, or equalizer piston, on front end of shaft into which air from high pressure end of compressor can pass.

MAINTENANCE



Flat concrete slab beneath propeller on tiedown line prevents stones and dust from being drawn up by backwash. Saving on company planes and propellers is estimated at $400 yearly.

Lehigh's EXTRA Service Keeps Bringing 'Em Back

By EDWARD E. THORP, *Assistant Editor, "Aviation"*

"Repeating" can make or break an airport business—it all depends on who does the repeating. If the service is poor, it'll be you—constantly and expensively reiterating your sales effort to flyers who won't come again. But if your service is good, filling man-and-plane needs from landing to takeoff, then you'll enjoy real business-building repetition—by pleased customers.

WHEN A VISITING FLYER makes his initial landing at Allentown-Bethlehem Airport, it's an odds-on bet that it won't be his last visit—for it's a rare man who isn't "sold for next time" on the comprehensive service afforded there by Lehigh Aircraft Co.'s efficient staff.

Accented by Manager W. M. "Wiley" Post, Jr., is the policy that the best—and most economic—business is to give service that *keeps* a man sold, and accordingly LAC's criterion is "quick and efficient care of every need of the airman, from the time he alights until the time he leaves." Here's how it works:

By the time an arriving airplane has taxied to a stop, the lineman is waiting to guide him to the tiedown line, unless he merely wishes to refuel, in which case he is shown the way to the pit. On the tiedown line, first thing which the visitor notes (see photo above) is a concrete slab, set in the ground beneath his pro-

peller, to prevent stones and dust from being drawn up when the engine is running.

Now the attendant is filling out a parking order (Fig. 1), noting amount and octane of fuel, quantity of oil, and any shop work required. He asks the visitor if he wishes transportation to town, if a hotel room shall be reserved, the hour at which he wishes to leave, and checks off or enters the information on the parking order, which is then attached to the plane. The bottom section of the p.o. is given to the pilot as a receipt. Next, a sheet of field rules and a flight plan is handed to him, including a list of local telephone numbers—hotel, taxi, CAA weather bureau, etc.—and he is then shown the way to the rest rooms and office.

If shop service is necessary on the plane, a specific card is made out for the work authorized on the parking order. This work card is kept in a rack (Fig. 2) beside a time clock, and time for each operation is recorded on it, together with the name of the mechanic and the amount of materials used.

To eliminate all possible waste motion, movable benches (Fig. 3) are brought to the plane, so that the mechanics can concentrate their labors close to the aircraft, instead of being required to make frequent time-consuming journeys across the hangar during the completion of the job.

Individual Parts Lockers

As parts and accessories are removed from the plane, they are stored (Fig. 4) in individual lockers, which are rolled up beside the bench, convenient to the mechanics. This system prevents loss or confusion of parts of similar planes or engines. The entire lot may be pushed around the shop when progress of the work necessitates moving from one location to another.

Parts which require thorough cleaning are placed in racks in a gas-fired degreaser large enough to handle anything smaller than a twin-row engine. Partitioned racks permit cleaning of several sets of parts without mixing, hence the mechanics need not rely on memory to separate them after they have been degreased.

Machine work and repairing are performed in a separate shop where each machine is provided with a board (Fig 5) carrying the tools and accessories used for various operations. Results are neatness and accessibility of tools, giving an instant check of anything out of place. Thus, loss of tools—a serious circumstance in most shops—is eliminated, and accordingly extra expenses for replacements are cut to the vanishing point.

A separate building (Fig. 6) is used

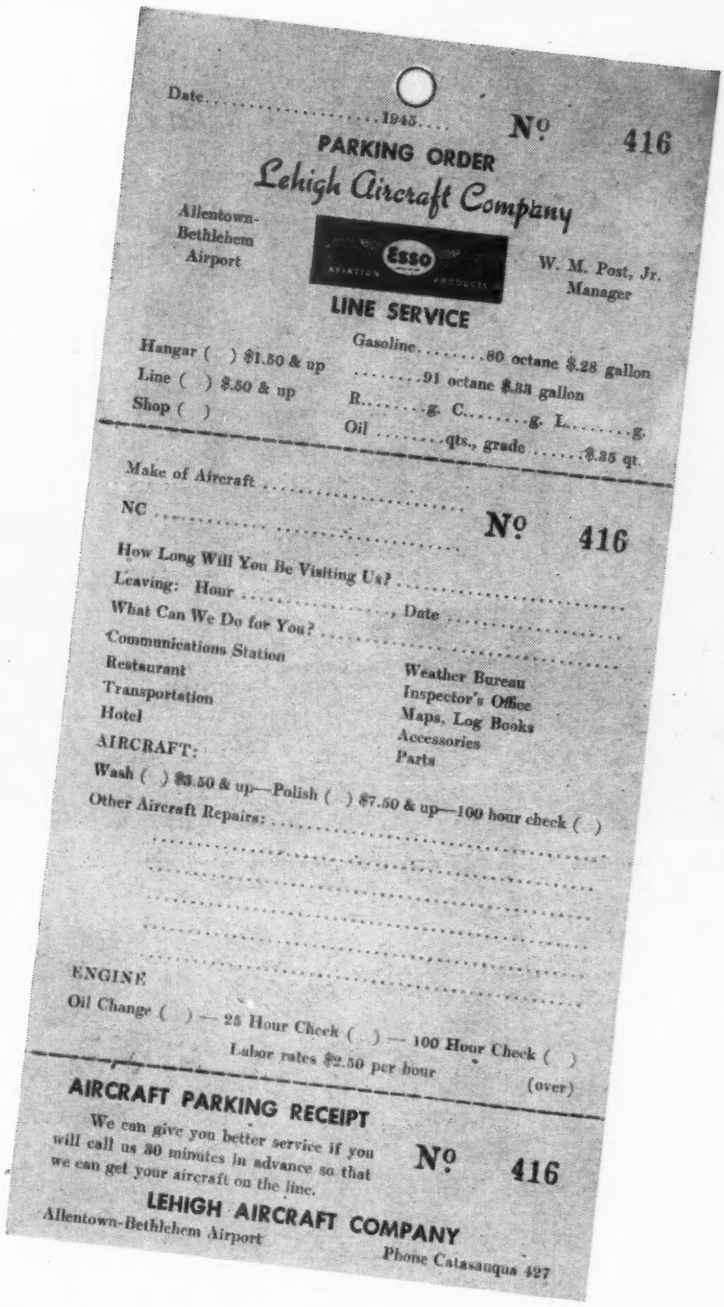

Date ..... 1945 ....
No. 416
PARKING ORDER
Lehigh Aircraft Company
Allentown-Bethlehem Airport
ESSO
W. M. Post, Jr. Manager
LINE SERVICE
Hangar ( ) $1.50 & up
Line ( ) $.50 & up
Shop ( )
Gasoline ..... 80 octane $.28 gallon
..... 91 octane $.33 gallon
R.....g. C.....g. L.....g.
Oil .....qts., grade .....$.35 qt.
Make of Aircraft .....
NC .....
No. 416
How Long Will You Be Visiting Us?
Leaving: Hour ....., Date .....
What Can We Do for You?
Communications Station
Restaurant
Transportation
Hotel
Weather Bureau
Inspector's Office
Maps, Log Books
Accessories
Parts
AIRCRAFT:
Wash ( ) $3.50 & up—Polish ( ) $7.50 & up—100 hour check ( )
Other Aircraft Repairs: .....
ENGINE
Oil Change ( ) — 25 Hour Check ( ) — 100 Hour Check ( )
Labor rates $2.50 per hour
(over)
AIRCRAFT PARKING RECEIPT
We can give you better service if you will call us 30 minutes in advance so that we can get your aircraft on the line.
No. 416
LEHIGH AIRCRAFT COMPANY
Allentown-Bethlehem Airport
Phone Catasauqua 427

Fig. 1. Parking order contains three parts. Bottom portion is detached and given to customer as receipt, while center portion is for checking various data and services to be performed and includes (on reverse) listings and authorization for shop work. Top section is hung on plane for identification and line service. Bill is itemized from two upper portions, each detail being specified.

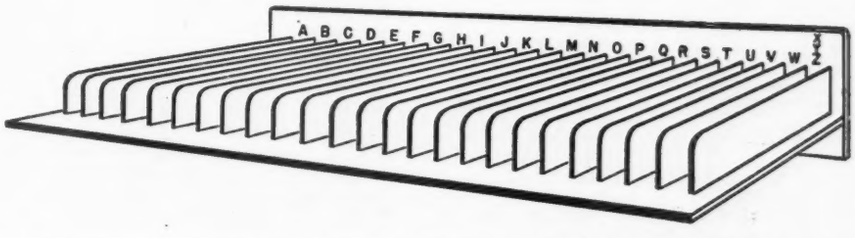


Fig. 2. Work cards are kept in alphabetical rack (as illustrated) during progress of job. Time for each operation is punched on cards (in and out), giving accurate cost data.

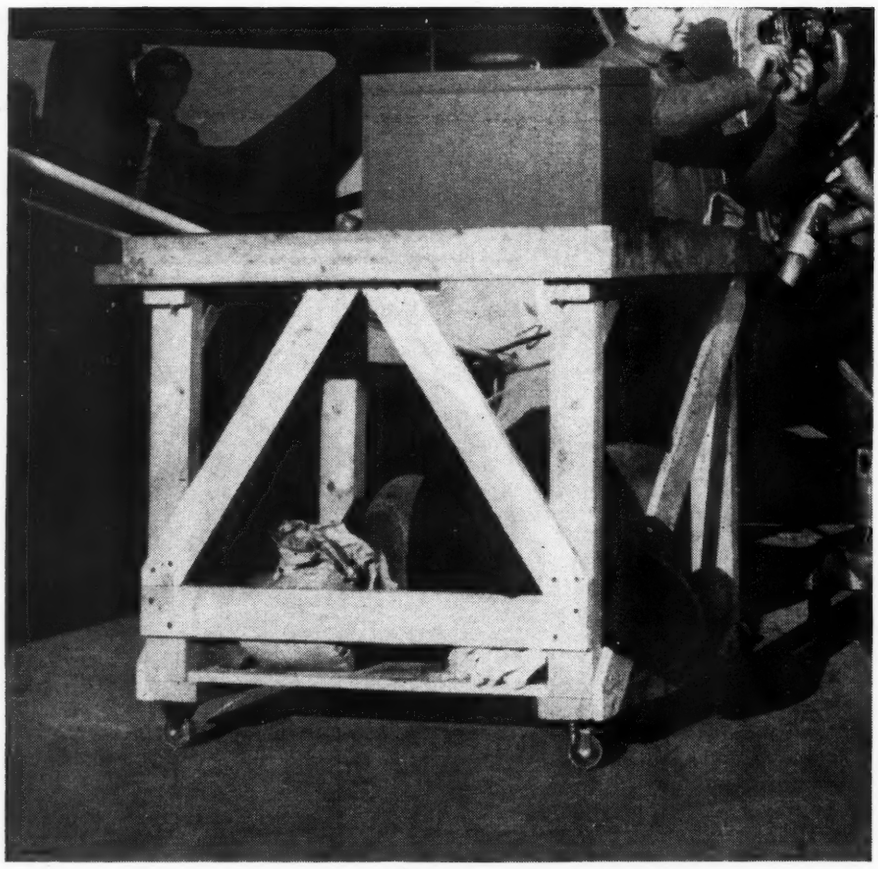


Fig. 3. Convenient benches, mounted on casters, simplify work on aircraft.

for engine testing—removed sufficiently far from the offices to prevent annoyance from noise. The operator is housed inside with his instruments, and the fuel tank is sufficiently distant from the engine under test to prevent any danger from backfires. The engine mount is bolted on the outside of the building where there is no problem of air supply or exhaust gas disposal.

This being a municipally owned hangar, business expansion brought up the problem of space. Part of the office area is taken up by United Air Lines and by CAA, so that the floor footage available for shops soon became too restricted. In order to use every square foot to best advantage, a dope and paint room was rebuilt (Fig. 7) with vertically folding walls which can be lifted to give a considerable additional working area. To guard against chance of igniting inflammable dope fumes, the lights in this section are set into the ceiling and covered with glass. Since the lamp housings ventilate outward, instead of into the dope room, fire from electric sparks is impossible. Ventilation of this room is downward, from top intakes to the exhaust fan at floor level, with the result that operators always breathe air which is free from fumes.

Re-covering jobs done here give assurance of long life through use of a fabric

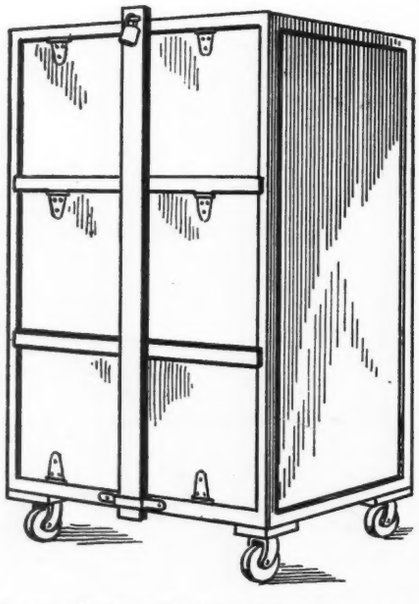


Fig. 4. Engine and plane parts are securely stored in these individual, castered lockers, made from old packing cases and using discarded materials for hardware.

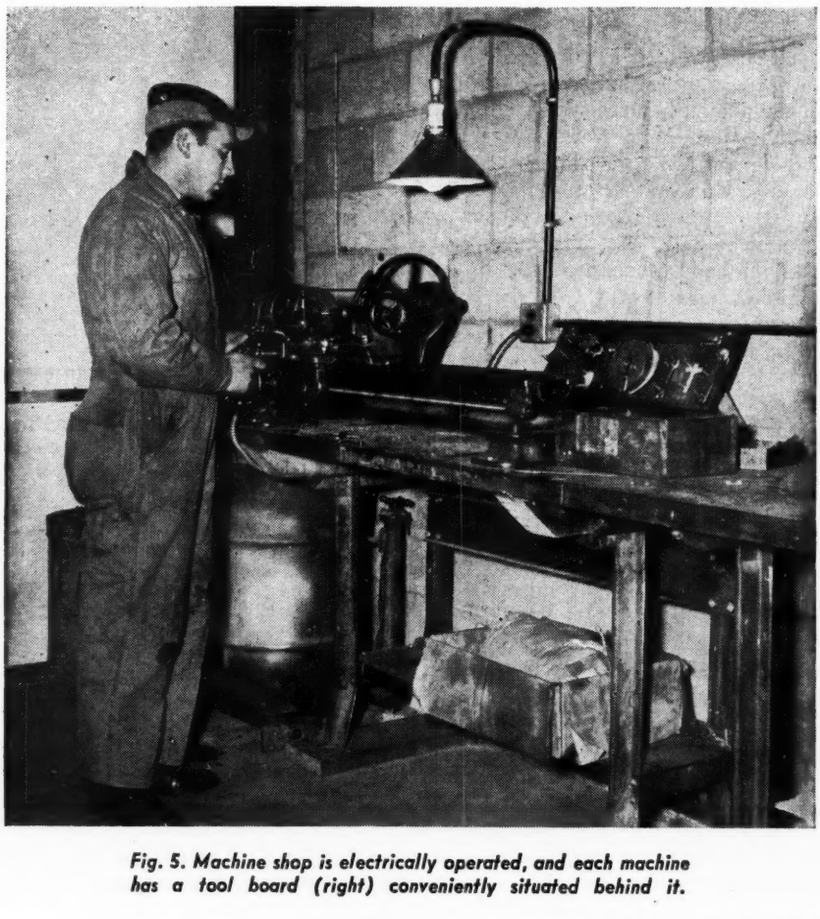


Fig. 5. Machine shop is electrically operated, and each machine has a tool board (right) conveniently situated behind it.

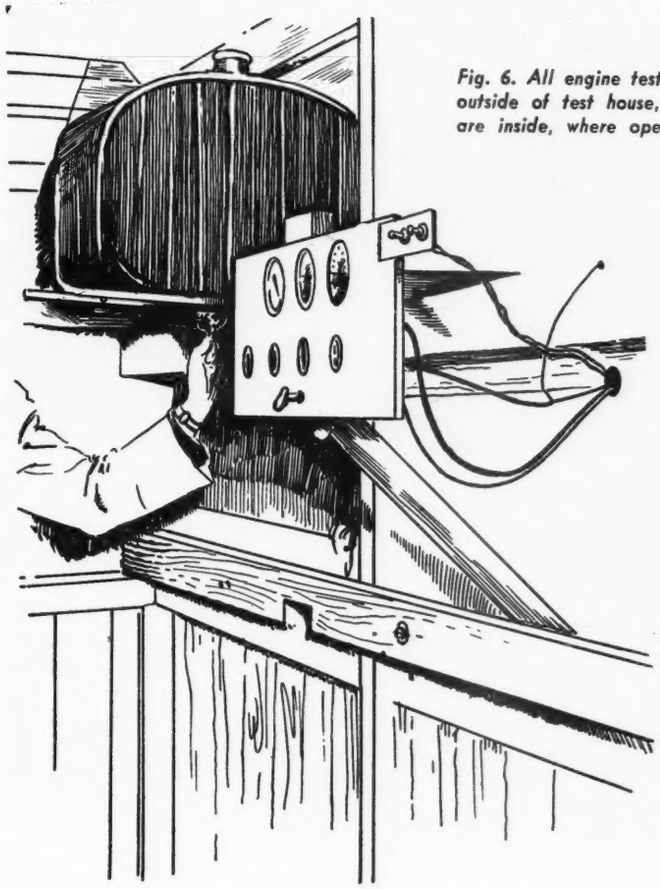


Fig. 6. All engine testing is done in open air. Engine is mounted on outside of test house, while fuel tank and instruments (see above) are inside, where operator can record results undisturbed by noise.

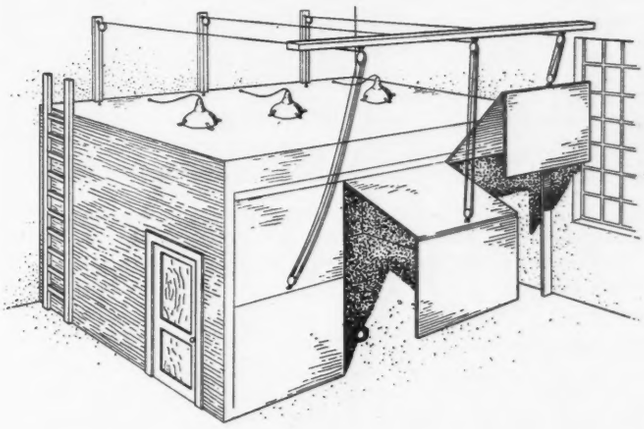
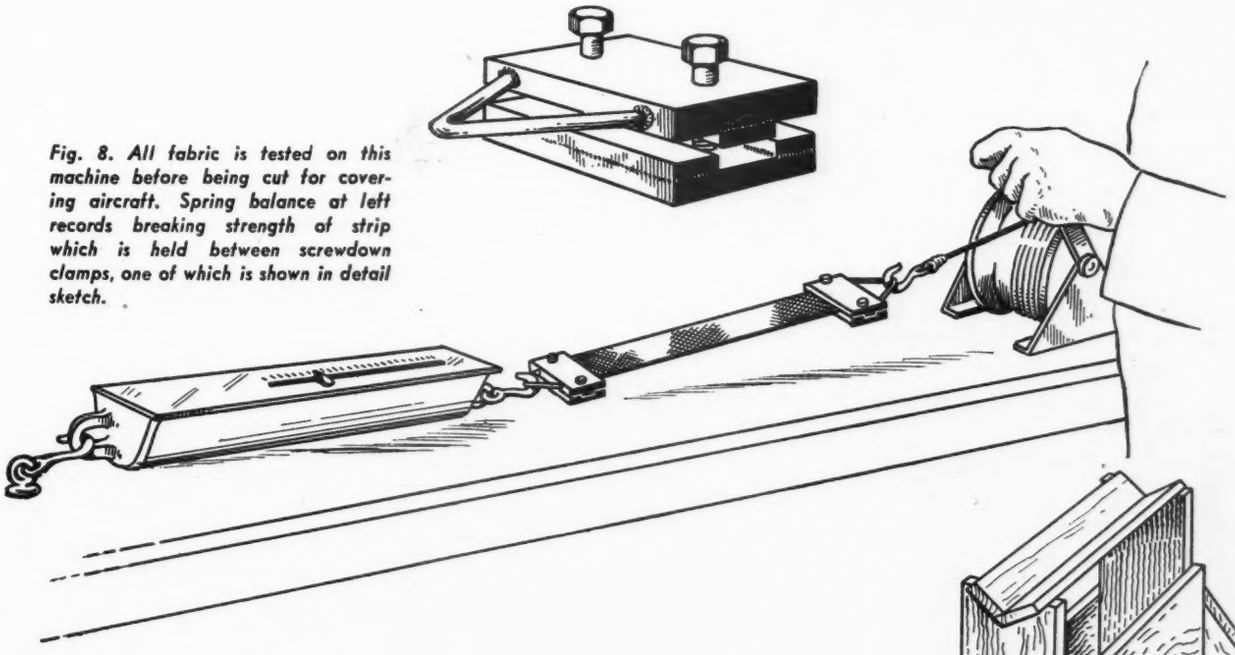


Fig. 7. To take advantage of every foot of space, dope-room walls fold up to ceiling when floor is required for other uses. These panels are in three hinged sections which lock into airtight wall when down. Ceiling lights are behind glass covers, thus avoiding possible fire hazard from wiring. Exhaust fan draws fumes from floor level, while air inlet is at top, giving downdraft which keeps air clear of fumes.

Fig. 8. All fabric is tested on this machine before being cut for covering aircraft. Spring balance at left records breaking strength of strip which is held between screwdown clamps, one of which is shown in detail sketch.



tester (Fig. 8) which affords measurement of the tensile strength of samples from each piece of material. Strips of fabric are tested for stretch and breaking strength so that the completed work will be of uniform quality.

While awaiting delivery, finished aircraft are stored on nose rests (Fig. 9) which allow a large number of planes to be stored in a comparatively small space. These rests were made, at minimum expense, from scrap lumber in the shop.

One of the departments in which efficiency saves the customer much time, and accordingly money, is the stockroom. Fig. 10 shows the method used for storing small parts which have been purchased in quantities. To expedite com-

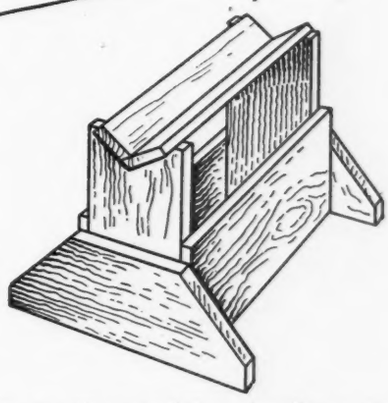


Fig. 9. After completion, aircraft are stored by using this nose rest, made from planks bolted together.

Fig. 10. Small parts are kept in labeled drawers in stockroom having loudspeaker for interdepartmental communication, also stock record file (left). Vacuum machine behind stock clerk) is used for cleaning cabin interiors.

Fig. 11. Here is stock record system used for re-ordering. Running check is kept of parts issued. Groups are marked "order when down to 10" or, say, "order when down to 25"—all according to turnover. This method assures continuous supply without overstocking.

munications between departments, a loudspeaker system has been installed, so that an order can be called in from the shop and be ready for delivery by the time that the mechanic arrives with the requisition. A file for these papers is kept on top of the bench, enabling the stock clerk to keep an up-to-the-minute record with a minimum of clerical labor. A vertical vacuum cleaner will be noticed in the picture. This is used for cleaning cabins of all visiting planes—a service which is just as standardized as cleaning the windshield.

Gaskets call for special handling—being classified both in size and with regard to different engine models. These items are hung on the wall, each size separate, and each engine model having a board for itself. Since the number and price is plainly marked with each gasket, there is no need to look up data in a parts list—another saving of time.

To avoid under- or overstocking, a card record (Fig. 11) is kept of every item. This record is posted periodically from stockroom requisitions. To simplify checking, cards for parts which must be re-ordered when down to the same quantity are kept in the same section of the file. For instance, in the illustration, parts of one side of the file are to be re-ordered when down to ten pieces. Whenever the stock clerk sees that any item is down to its specified minimum number, he re-orders immediately, without the need for checking other lists.

After the plane has been serviced or repaired, the customer's time for departure is checked on the parking order. The plane is run out, tanks are filled, and the engine is warmed up ready for takeoff at the scheduled minute. A stamped postcard (Fig. 12) is placed on the pilot's seat where he will see it after getting into the plane. The hundreds of returned cards, which carry many evidences of satisfaction, are an excellent check both on the service given and on new trends in visitors' requirements.

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ALLENTOWN-BETHLEHEM AIRPORT

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Lehigh Aircraft Company

Dear Visiting Pilot:

We trust your visit at the Allentown-Bethlehem Airport has been enjoyable. Of course, there are lots of things we would like to do for you, such as furnishing hangar space and so forth, but until the war is over, we cannot.

However, the things we can do, we are trying to do well and it will help us a lot and may make your next visit more enjoyable if you would check the following questions and mail this back to us. No postage necessary.

Thank you very much for this information. We trust we can be of further service to you.

W. M. Post, Jr., Manager
Lehigh Aircraft Company

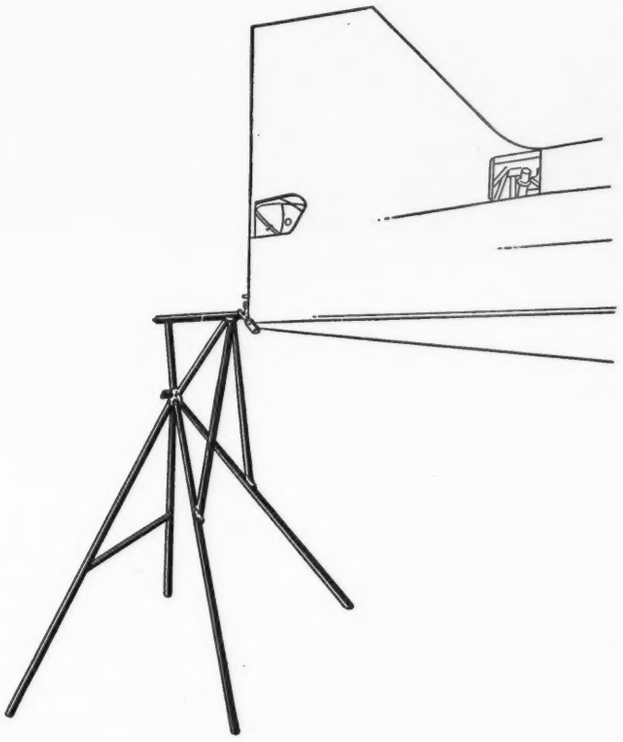
	Yes	No
On arrival were you shown where to park your airplane?	☐	☐
Was your airplane gassed and oiled without unnecessary delay?	☐	☐
Was your windshield cleaned?	☐	☐
Were you asked if you wanted transportation into town?	☐	☐
Were you told where you could find the weather and clearance office?	☐	☐
Was the mechanical service you requested done promptly and well?	☐	☐
Were you given courteous service?	☐	☐
Do our prices compare favorably with other airports you have visited?	☐	☐

Remarks as to how our service can be improved:

Airplane NC _____ Date _____ Pilot _____

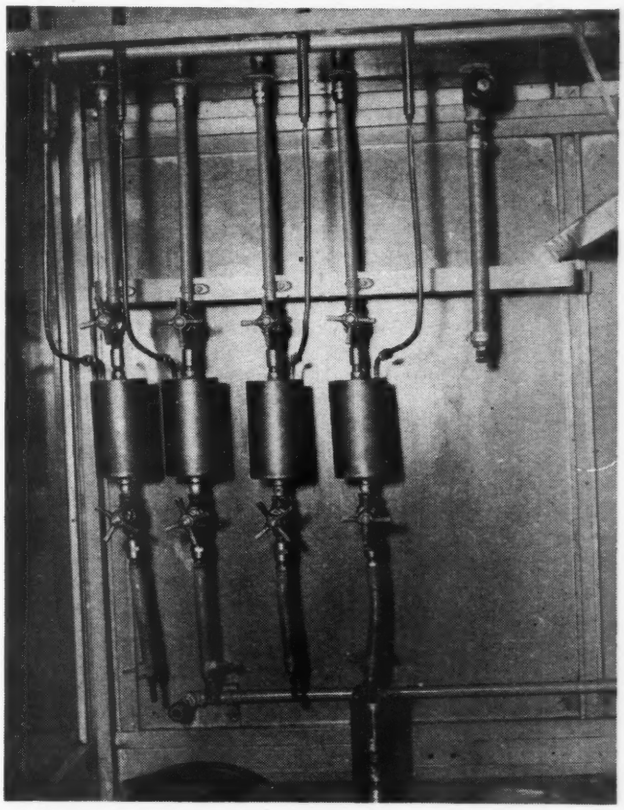
Address _____ City _____ State _____

Fig. 12. When bill has been paid, departing visitor is handed postcard (shown here front and reverse) which not only serves as a check on service and maintenance, but impresses upon him fact that his continued custom is desired. Result: More than 90% come back.



Pivoted Fuselage Stand Affords Many Advantages

• Built of old aircraft tubing, a pair of these stands permits lightplane fuselages to be doped and sanded to a completed job without lifting or other handling. Balanced fuselage is easily turned to expose fresh surface for spraying or sanding. Stand was devised and built by Aviation School & Service, Lake Susquehanna Airport, Blairstown, N. J.

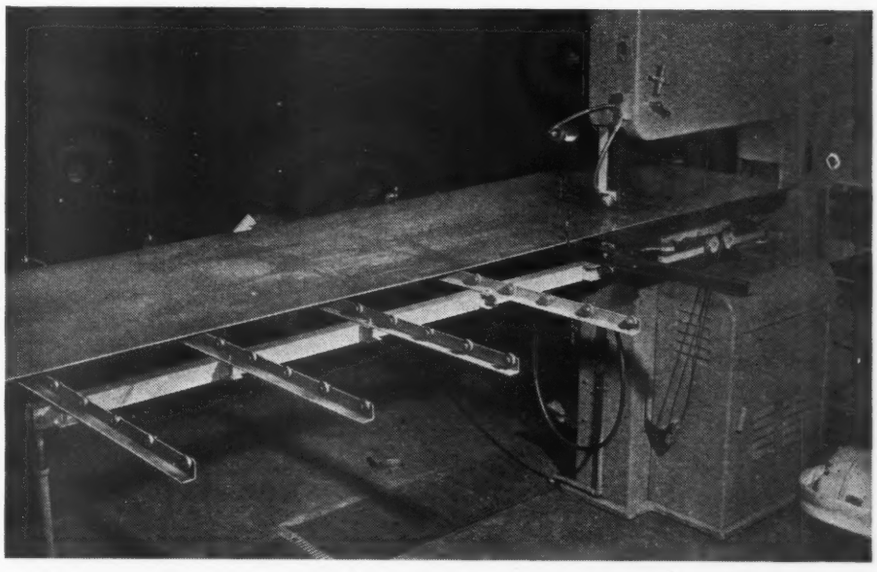


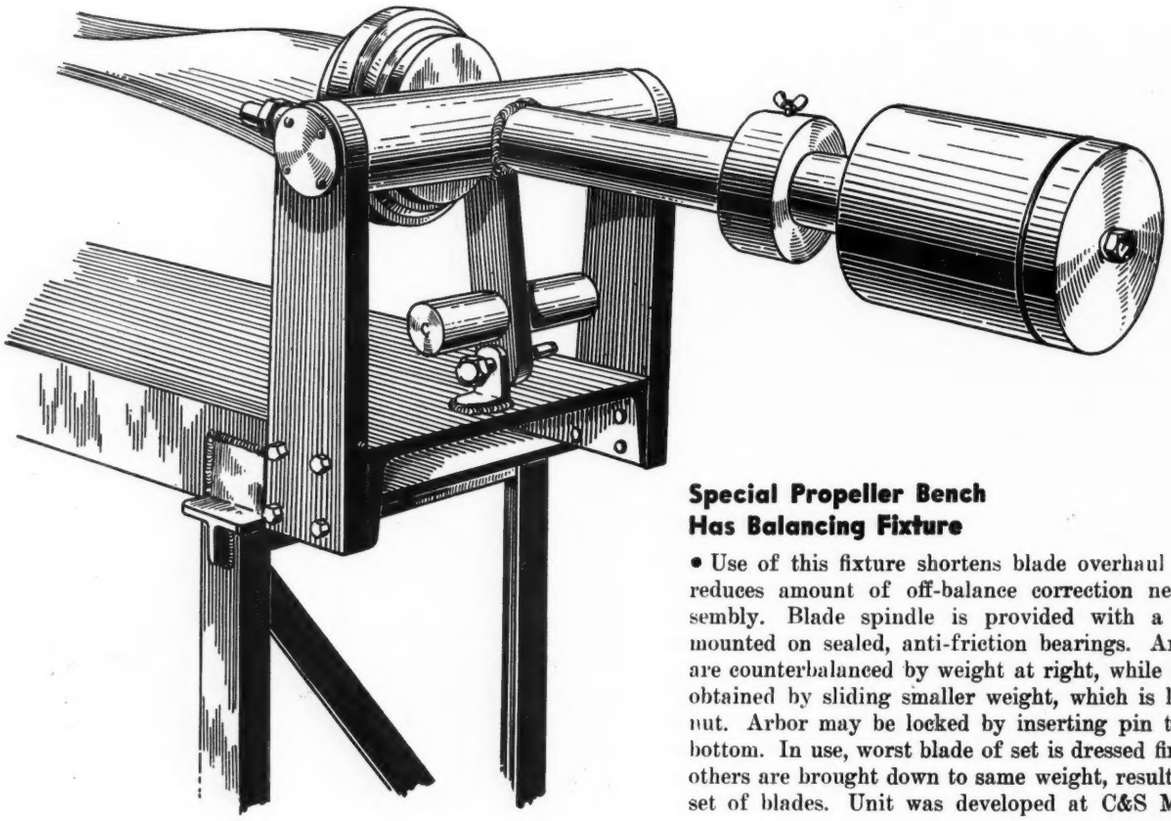
Fountain Refill Service For Fire Extinguishers

• Fed from overhead tank, these containers accurately measure carbon-tetrachloride for filling fire extinguishers. Nozzle of hose is tapered to fit tightly into opening of extinguisher, preventing fumes from escaping into room. Device was developed at Middletown ATSC.

Roller-Equipped Table Saves Two Men's Time

• Equipped with discarded airscoop bearings, this table enables large metal sheets to be handled easily by one man, saving time of two others formerly required to assist in sawing operation. Table was designed and built by Leo Ragan, TWA's master mechanic at Kansas City, Mo., shops.



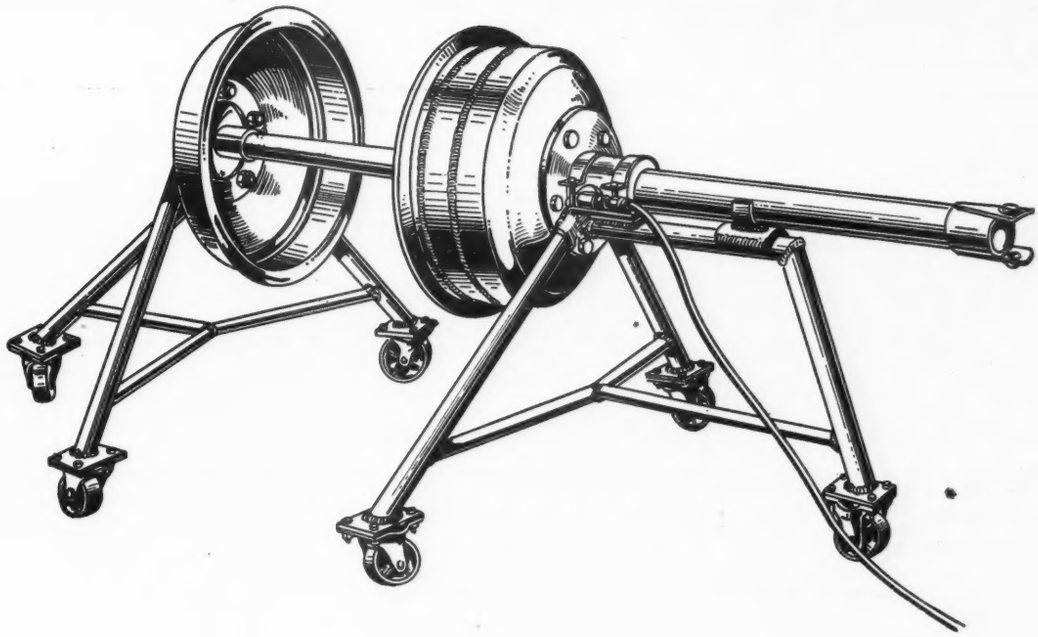


Special Propeller Bench Has Balancing Fixture

• Use of this fixture shortens blade overhaul procedure and reduces amount of off-balance correction needed after assembly. Blade spindle is provided with a pivoted arbor mounted on sealed, anti-friction bearings. Arbor and blade are counterbalanced by weight at right, while final balance is obtained by sliding smaller weight, which is locked by wing nut. Arbor may be locked by inserting pin through arm at bottom. In use, worst blade of set is dressed first, after which others are brought down to same weight, resulting in matched set of blades. Unit was developed at C&S Memphis shops.

Multiple Tank Line Speeds Parts Cleaning

• By employing a series of tanks set beneath track of an overhead hoist, EAL has greatly expedited washing of engine parts. Steelplate basket travels entire length of tank line without need for handling of contents by operators. At end of line, contents are lifted out and basket is returned for reloading.



Old Plane Parts Make Useful Press

• Employing discarded brake drums and old retracting cylinder from Douglas DC-3, C&S made this oil-operated press for loosening of tire beads from flanges. Both time and tires are saved by performing this regular service operation by means of this unit instead of by hand. Oil pressure is from shop line.

Field Service Truck Expedites Engine Change

• High-speed truck, fitted with chain hoist and track, enables AAA to change engines in field, regardless of weather. With its service covering a large and mountainous territory, company finds it advisable to make repairs at scene of trouble, rather than tow planes back to Pittsburgh base. For this reason, this truck is fitted with extension and steel bows, so that tarpaulin may be used for protection during wet weather use.

MILITARY

REPUBLIC UNVEILS SPEEDY XP-84 JETPLANE

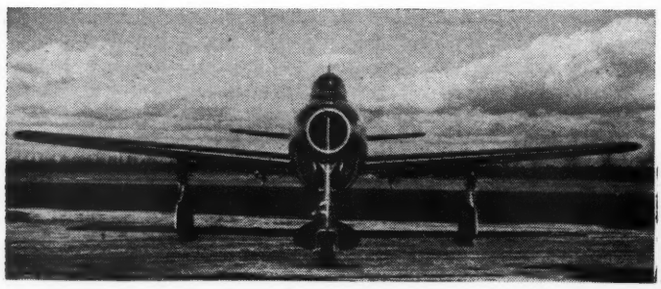
New AAF fighter, powered by axial-flow GE TG-180, is now being test-flown at Muroc. Meanwhile, company is already at work on order for 100 sister craft.

ANOTHER INDICATION of the Services' shift to all-jet air forces is the new Republic XP-84, powered by a single GE TG-180 (J-35) axial-flow turbine. This new warplane is understood to be in the 600-mph. speed class.

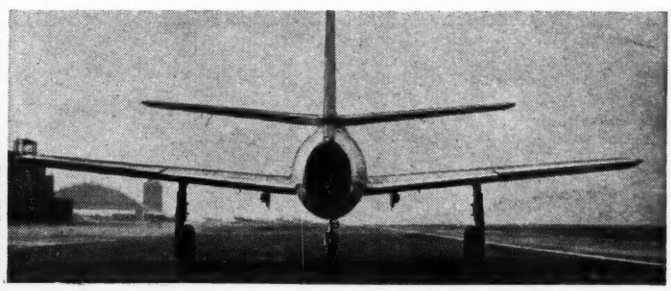
Designed and built in utmost secrecy, the XP-84 was quietly flown (crated within a Boeing XC-97 cargo transport) to the AAF's high speed flight test station at Muroc Field, Calif., where it was assembled and flown for the first time on Feb. 27 by Maj. W. A. "Wally" Lien. Maj. Lien is the company's new test pilot for jet-propelled planes.

Some measure of the craft's design may be ascertained from the fact that the company already started production of over 100 P-84s before the prototype made its first flight. The company wants to name the plant the Thunderjet, to denote succession to the Thunderbolt.

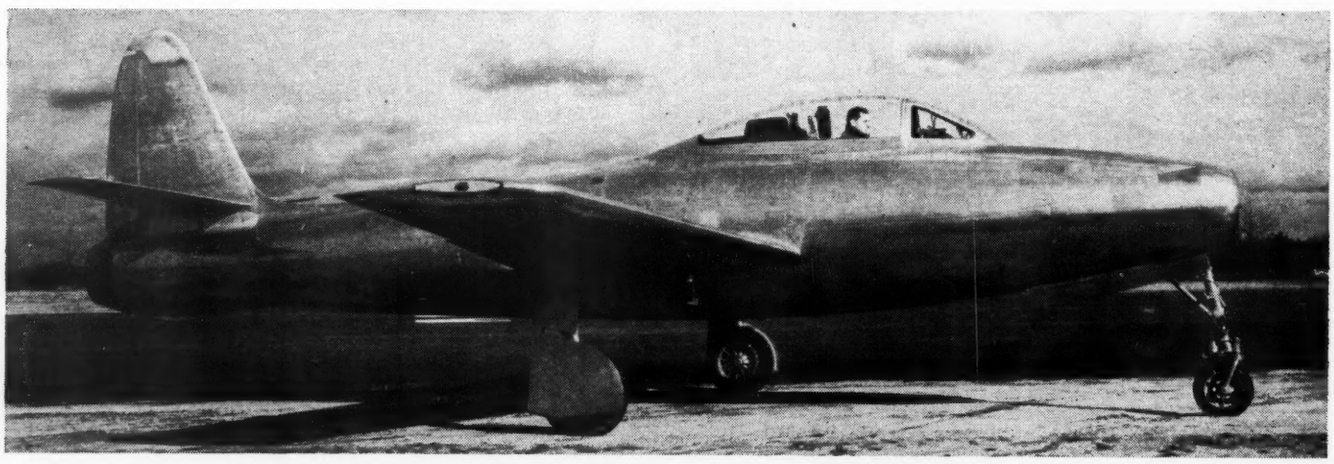
Since the first airplane has only recently been delivered and flown, no performance figures are yet available.



Of low-midwing design, new fighter has both wide landing gear tread and wheelbase, which should give good stability on ground. Clearly depicted here is nose orifice with split duct. New power plant is believed to be more powerful than I-40. Guns are set about nose.



Jet exhausts through opening set below tail surfaces. Because of extremely clean lines, craft probably has very low drag factor when in full flight with landing gear retracted. Elevator and fin, set well above fuselage center line, have a slight dihedral.



Long, slim lines of new Republic XP-84 are apparent in this view of AAF's newest turbojet-powered fighter. Construction is all metal, including, it appears, covering of control surfaces. Lengthy bubble-type canopy, and cockpit set in front of wing, affords pilot fine visibility. Note vanes set in wheel disks to start rotation of wheels when landing gear is extended, thus reducing tire wear due to impact.

Luscombe Testing Low-Wing One-Placer

Speedy all-metal craft, with 2-mph./hp. speed ratio, uses many Silvaire components and makers state it has very low fuel consumption at cruising speeds. Company is now studying marketing possibilities.

LATEST in the bevy of single seaters being readied for personal flyers is the new Luscombe Model 10, a low-wing design now being tested at the company's Dallas plant.

Of all-metal construction except for fabric-covered wings, the prototype is powered by a 4-cyl. 65-hp. Continental engine, which is stated to give the craft a top speed of more than 135 mph. and a cruising speed of 122 mph. The company states that this performance makes the Model 10 the fastest plane in its class. At cruising speed, fuel consumption is stated to be only 4 gal./hr.

Many of the parts used in fabrication of the new plane are said to be identical with those used in the company's Silvaire two-placer; thus, when production of the Model 10 is decided upon, tooling and turnout should present few problems.

Span is given as 25 ft., overall length as 17 ft., and gross weight 845 lb. Featuring a bubble-type canopy, together with fillets at the wing roots and landing gear, the craft has a racy appearance. The fixed landing gear is fitted with oleo shock struts.

From drawing board to finish took only six months. The work was under the supervision of Engineer Misha Kantor.

As yet the company has not decided upon price or marketing plans, but a study is being conducted to determine whether public demand would warrant quantity production.

Luscombe Silvaire and Model 10 pose together aloft near company's Dallas plant. Many parts of both types are interchangeable, a factor that would simplify simultaneous production.

Closeup view of Luscombe Model 10 one-placer gives some measure of new craft's compactness and finely faired lines. Continental 65-hp. engine, turning wood fixed-pitch propeller, gives plane 135-mph. top speed. Fuel consumption, at cruising speed, is stated to be less than that of a comparable auto. (Thomas K. Cone photos)

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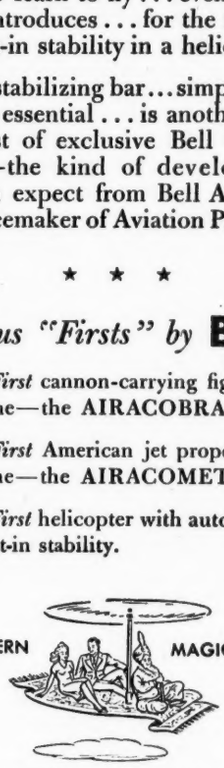
- *First* helicopter with automatic, built-in stability.



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PACEMAKER OF AVIATION PROGRESS

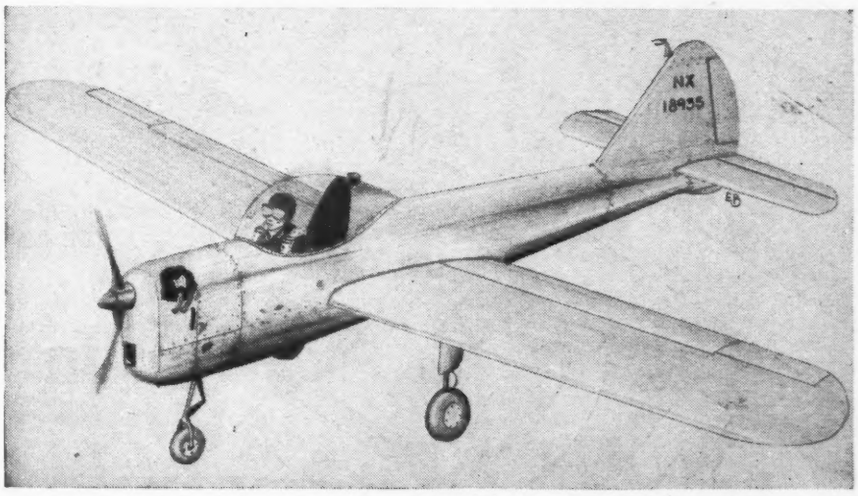
TWO-CONTROL SKY SKOOTER IS THORP ENTRY

A side-by-sider with tricycle landing gear, new craft features novel level-flight device for ease of control in windy weather. Seen as initially selling for about $1,800, lower price is envisioned by maker if mass output is attained.

NAMED THE SKY SKOOTER, a new 2-place side-by-side personal plane is being built by the John W. Thorp Co., Burbank, Calif., and is scheduled to begin flight tests this summer. Mr. Thorp was formerly associated with the design of Lockheed's Little Dipper, and since observers have noted resemblances between the two craft, the accompanying sketch of the Little Dipper will give some idea of the appearance of the forthcoming plane.

The Sky Skooter is planned for a cruising speed of 100 mph., landing speed of 35–40 mph., and a 400-mi. range. Service ceiling will be about 16,000 ft., and initial climb about 650 fpm. Takeoff over a 50-ft. obstacle in 500 ft., also landing over a similar obstacle within 400 ft., will also be sought. These performances are calculated on installation of a lightweight 2-cyl. 50–60 hp. engine.

Span is to be 25 ft., and length 17 ft. 6 in., but notwithstanding this small size, a cabin width at shoulder level, of 39 in. is planned. The cockpit will be located in front of the wings, and fuel tank will be behind the luggage compartment. In the early production stages it is estimated that the all-metal Sky Skooter will sell for approximately $1,800, with later models seen costing $1,000 or less with mass production.



Little Dipper (above) was earlier Skooter-like project engineered by Thorp while he was at Lockheed. This sketch is included to give readers a visualization, since no illustrations of new craft were available at this writing. Unique feature of both planes is horizontal tail which helps pilot correct for gusty conditions and thus helps keep craft flying level. Large fin should provide good stability. (AVIATION sketch)

Anti-Servo Control Device

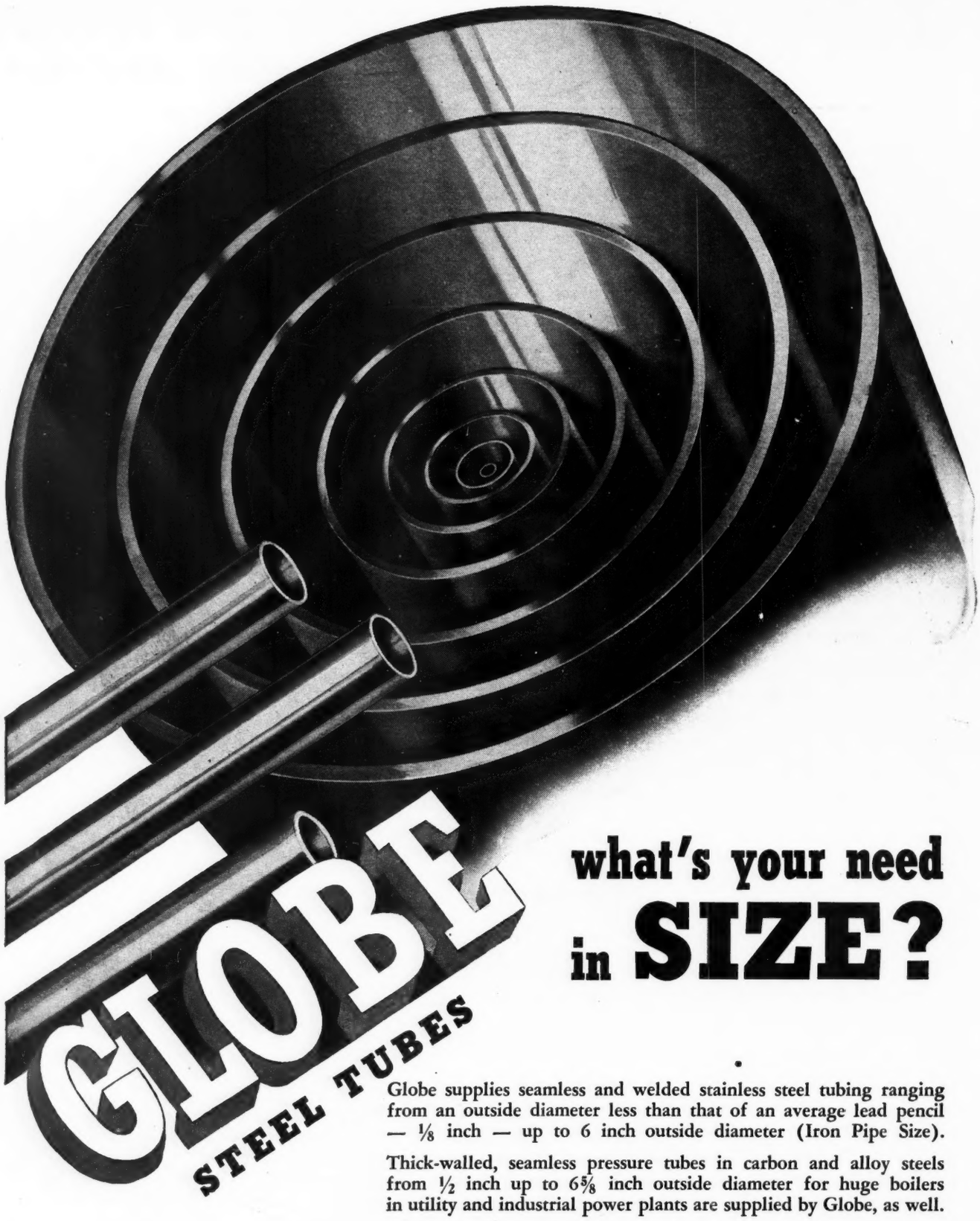
Spinproof and stallproof controls are to be installed, with stick and pedal tube-linked to the control surfaces. The large flaps are to be lever actuated. A novel feature will be the use of a free-moving stabilizer fitted with an anti-servo. It is stated that this device will tend to automatically neutralize the control surface in gusty air, and thus greatly aid the pilot in controlling to maintain level flight. Landing gear is to be fixed tricycle.

Re Little Dipper

Since a similarity between the Sky Skooter and the Lockheed has already been noted, a few details of the latter are pertinent. Span of the Little Dipper is 25 ft. Engine is 2-cyl. 50–60 hp.

A great deal of flying time has been accumulated on this craft, and many favorable comments have been made on its flying qualities, short takeoff and landing runs. For a while, the AAF tested the craft, probably considering its value for liaison work.

Construction is metal, and a fixed tricycle landing gear and a control system similar to that of the Sky Skooter are fitted. As yet Lockheed has not announced any plans to put the Little Dipper into production.



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5025

ROSS SPORT PLANE SET FOR PRODUCTION

Aimed at low-price field, lightweight two-seater by N. Y. C. firm, features simplified structure for ease of production and low maintenance costs.

DESIGNED FOR USE by airport and flying school operators, also personal pilots, the Ross RS-2L Sport Plane tandem two-seater is scheduled to go into large-scale production at an early date. Granted an Approved Type Certificate, the plane is a product of Ross Aircraft Corp., 420 Lexington Ave., N.Y.C.

Span is 30 ft., length 20 ft., height 7 ft. and wing area 147 sq. ft. Powered by a 65-hp. Lycoming, top speed is stated to be 103 mph., cruising 90, and landing 38. Rate of climb is 500 fpm., and range at cruising speed is 230 mi. Weight empty is 555 lb. and gross is 995. Wing loading is placed at 6.8 lb./sq. ft. Price of the RS-2L is given as $1,320 F.A.F.

Mixed construction is utilized. Wings, with a Clark Y section, are built in two panels, each attached to fittings on the cabane structure with horizontal bolts through each spar end. Wing panels are fabric-covered wood structures, with spruce spars of constant rectangular section. Compression ribs are solid spruce with lightening holes. Contour ribs are of spruce cap strip with plywood stiffeners.

Internal drag wires are of high-strength steel aircraft wire threaded at the ends and installed without fittings by letting them extend through the spars, with nuts and washers fitted against beveled blocks on the front of the front spar and at the rear of the rear spar. External brace struts are chrome-moly steel streamline tubes, one to each spar. The lower ends are adjustable to simplify rigging.

Fuselage is a fabric covered structure of welded chrome-moly steel tube. It is stated that the fuselage shape has been designed to give the most room for pilot and passenger with least hindrance to vision, and at the same time to provide for attachment of wings and landing gear using the fewest members and at the best angles. Longerons terminate at a single vertical post at the rear, with four longerons in the cockpit area tapering to three aft of the pit. Cabane and landing gear struts are welded directly to the fuselage structure.

Rudder and elevator are of sheet dural riveted to steel torsion tubes. The rudder pivots on spindle hinges at the top and bottom of its torque tube. Rudder spar ends are fitted with bronze bushings. The elevator pivots on four strap hinges. Stabilizer and fin are fabric-covered steel tube frames. The stabilizer is adjustable on the ground, and the entire empennage is externally wire braced.

Landing gear consists of 16x7-3 or 7.00 x 4 Air Wheels mounted on axles bolted directly to the struts. The wheels are the sole shock absorbing medium. A tail wheel is fitted to a leaf spring.

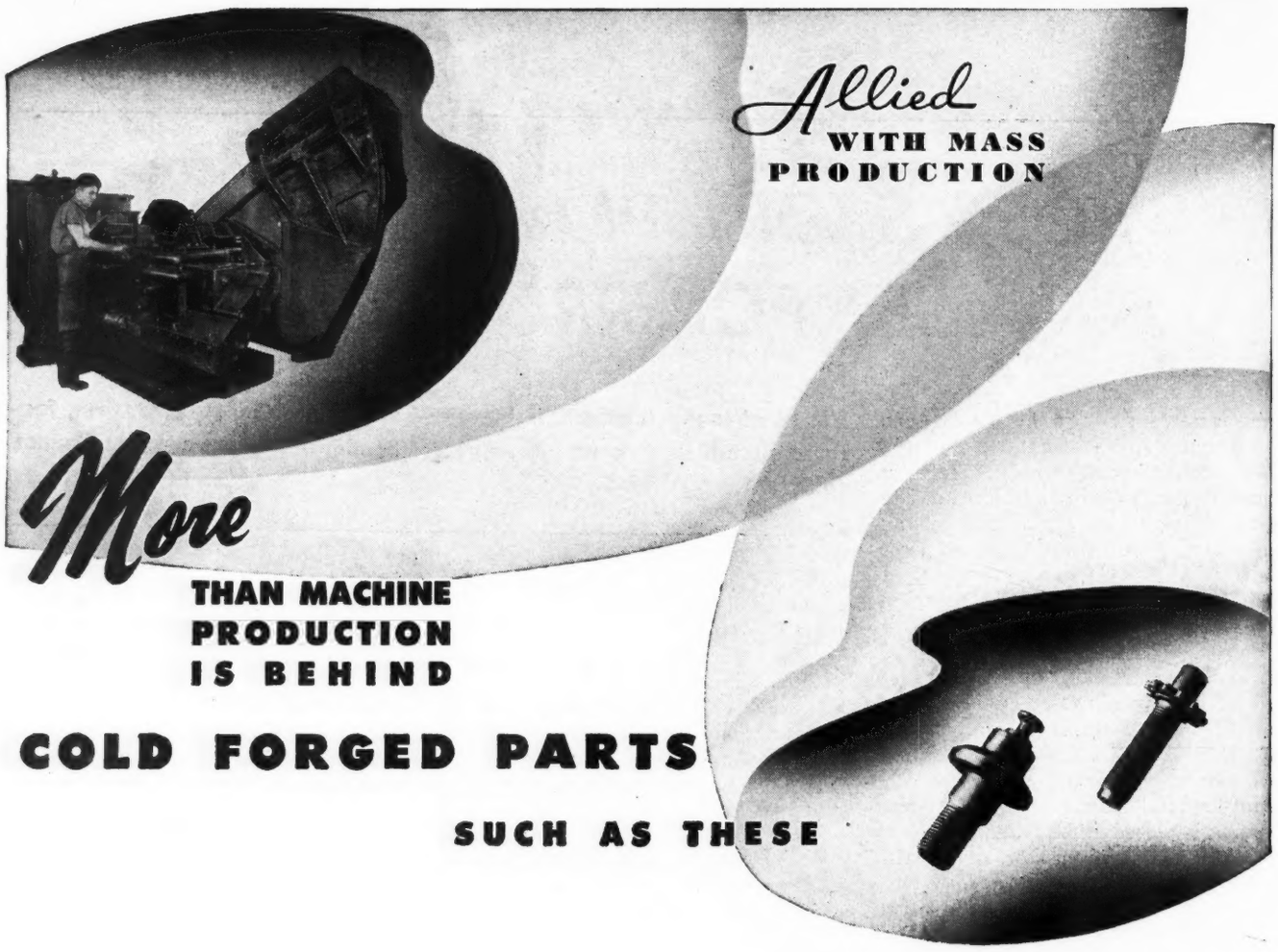
Fuel tank, of 12-gal. capacity, is made of tern plate, conforming to the shape of the fuselage, and it is not covered. Fuel lines are copper tube with hose connections. Engine controls consist of ignition switch, throttle push and pull rods, and a primer. All plane and engine control fittings are installed in both cockpits.

Standard equipment consists of the following: Altimeter, tachometer, oil pressure gage, oil thermometer, and airspeed indicator. Flooring is 3-ply. Seats are sheet aluminum with plywood bottoms, and a safety belt is provided for each seat. One-pint fire extinguisher and first-aid kit are also included. A cabin enclosure would be furnished as extra equipment.

Specifications and Data

Span	30 ft.
Chord	5 ft.
Aspect ratio	6:1
Length	20 ft.
Height	7 ft.
Wing area	147 sq. ft.
Gross weight	995 lb.
Payload	192 lb.
Empty weight	555 lb.
Wing loading	6.8 lb./sq. ft.
Power loading	15.3 lb./hp.
Top speed	103 mph.
Cruising speed	90 mph.
Landing speed	38 mph.
Takeoff run	380 ft.
Rate of climb	500 fpm.
Service ceiling	14,000 ft.
Gas consumption (cruising speed)	3.8 gal./hr.
Range (cruising speed)	230 mi.
Power plant	65-hp. Lycoming O-145-B3
Price	$1,320 F.A.F.

Tagged at $1,320, Ross Craft is a two-place parasol of metal, wood, and fabric construction, with power supplied by a 65-hp. Lycoming. Credited with 103-mph. top speed, plane has 230-mi. cruising range, and weighs but 995 lb. Company expects to go into production soon.



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KAISER-HAMMOND PRESENTS METAL TWO-CONTROL PUSHER

Resembling prewar Hammond Y, four-five seater in $4,000-$5,000 class mounts 220-hp. Lycoming. Company, which teams West Coast industrialist with well-known safety plane designer, is now investigating production facilities for craft.

FLIGHT TESTS have been started on the new Kaiser-Hammond pusher family plane at Oakland Airport, Calif. Marking the re-entry of Dean Hammond in the personal plane field, the craft bears many similarities to the prewar Hammond Y, although it is much roomier and higher powered.

Seating is for four with luggage or for five without it. Span is 40 ft., same as the Y, but length is 28 ft., as against 26 ft. 10 in. for the earlier craft. Gross weight is given as 3,000 lb., with weight empty at 1,800 lb.

Powered by a 220-hp. Lycoming, smoothly faired into the rear of the streamlined cabin, the plane is expected to have 140-mph. cruising speed and range of 600 mi. A two-control spin-proof stall-proof system has been incorporated, with ailerons and elevators controlled by a wheel, and with a pedal on the floor for the brakes. The large cabin door can be readily jettisoned in event of emergency.

Construction is all-metal, including the covering of fuselage, of twin tail booms, and of tail surfaces. Wings, of metal construction, are fabric covered on the prototype, but it is stated that on production models they will be metal covered. Landing gear on the present plane is fixed tricycle, but it is expected to be retractable on later planes. Shock travel is taken within the same type of streamlined pylons on the wings as were employed on the original Hammond Y.

Production plans have not yet reached a definite stage, but Mr. Kaiser quoted a $4,000-$5,000 price range for the plane when built in quantity. It is noted that the prototype will soon be flown east for further flight testing at the Fleetwings Div. plant in Bristol, Pa.

No decision had been reached, at this writing, on where the craft will be built. The company had stated that estimates of production costs in various possible manufacturing centers were being prepared as a basis for determining the place of manufacture.

New four-five place Kaiser-Hammond family plane is seen here warming up at Oakland Airport prior to flight test. Bearing a decided resemblance to old Hammond Y, new craft is spin-proof and stall-proof, and it is designed for 140-mph. cruising speed. Landing gear now is fixed, but on later models it will be retractable. Scoop for 220-hp. Lycoming may be noted beneath fuselage. (Press Assn. photo)

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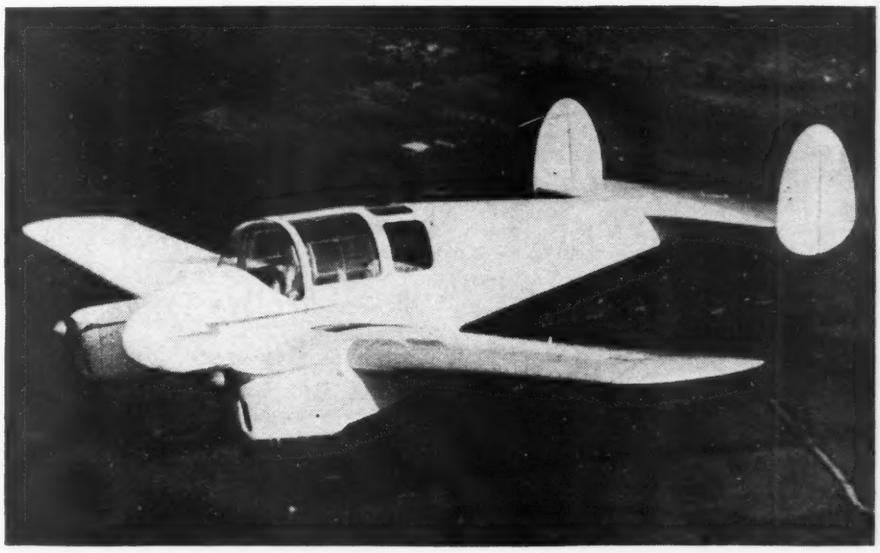


Miles Gemini four-seater is compact simple-lined craft, powered by two 100-hp. Cirrus Minor engines. Range is given as over 6 hr. at cruising speed.

Gemini Four-Placer Is Miles' Latest

British firm introduces light all-wood twin-engine craft for personal or charter flying. New skyster has retractable landing gear, and top speed is put at 150 mph.

OFFICIAL BRITISH EMPHASIS on design and construction of airliners and feederliners has not entirely halted development of lighter craft in Britain—as is evidenced by the appearance of Miles' new four-place personal and charter plane, the Gemini.

Powered by two 100-hp. Cirrus Minor engines, the Gemini has a span of 36 ft. 2 in., 22 ft. 3 in. length, 7 ft. 6 in. height, and a tread of 10 ft. 11 in. Gross wing area is given as 191 sq. ft. At 2,800-lb. gross weight, the following performance is estimated: 150-mph. top speed, 130-mph. cruising speed, sea level climb of 850 fpm., still air range with 60 gal. of 820 mi., and 35-mph. stalling speed.

Wood construction is utilized throughout, with the fuselage made up of U-shaped frames, each composed of inner and outer laminated spruce members covered with ply skin panels. The laminated members are inter-spaced by blocks and reinforced where local strengthening is required. Inspection panels are secured by quick release fasteners, providing access to the controls beneath the forward floor and at the fuselage rear. A luggage compartment is located in the nose.

Wings are full-cantilever all-wood structures, with the complete assembly consisting of mainplane primary structure, ailerons, and Miles lift flaps. Ailerons are of the drooping slotted type. Two flexible fuel tanks are fitted within the wings, and arrangements are being made for installation of auxiliary tanks.

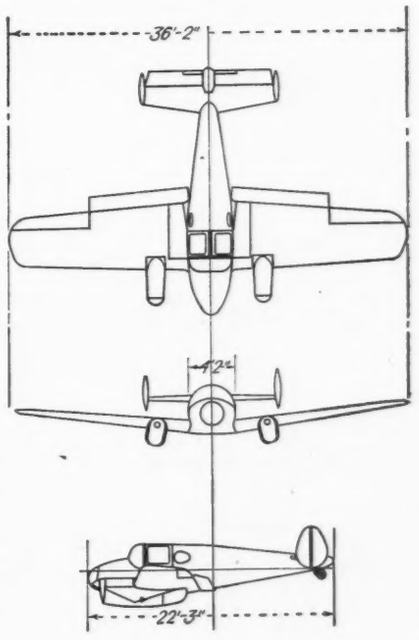
Tail unit assembly consists of a cantilever tailplane, elevator with trim tabs, and twin fins and rudders. Trim tabs are operated by a handwheel mounted at the left side of the pilot's seat, and a rotary position indicator graduated in degrees is mounted on the cabin auxiliary panel. Rudder pedals are adjustable.

The 4-ft. wide cabin has side-by-side tandem seating, features controlled ventilation, and is soundproofed. The pilot's seat is adjustable on the ground, and both front seats are hinged to tip forward to provide access to stowage space in the floor. Rear seat, running the full cabin width, is upholstered in soft leather and equipped with cushions.

Full instrument and blind flying equipment is mounted on the main instrument panel. A subsidiary panel, installed on the left side facing the pilot, is balanced on the opposite side by a large pocket for charts and other accessories. There is provision for fitting dual controls.

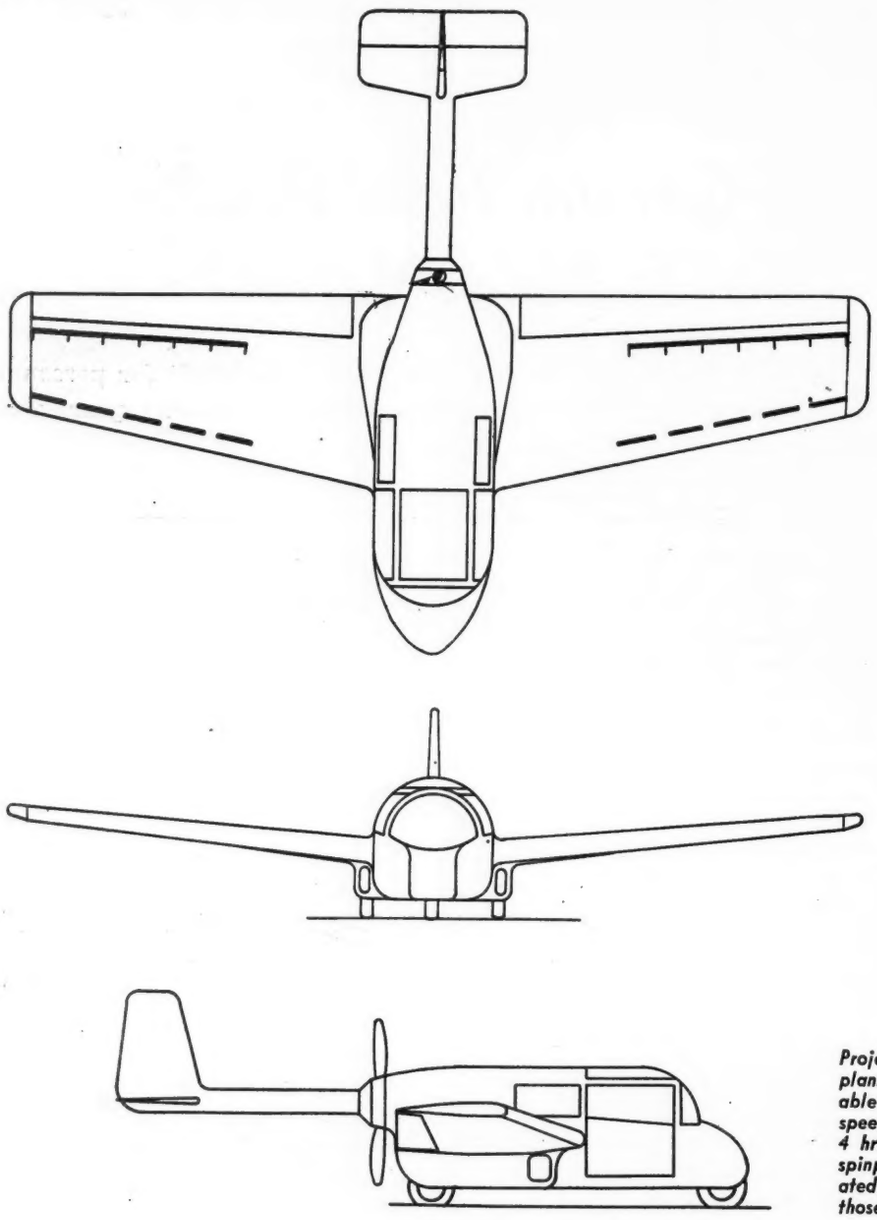
A one-piece Perspex windshield is molded to the contour of the front cabin section. Cabin doors may be jettisoned by operating a red-painted emergency handle which withdraws all the hinge pins simultaneously.

Main landing gear is fully retractable, while a full-swiveling tail wheel is fixed. It is stated that the Gemini can maintain flight on one engine.



Hervey Travelplane Is New Roadable Project

Four-place pusher craft with tricycle landing gear, designed by California inventor, will feature single tail boom going through propeller shaft. Cruising range of 4 hr. at 125 mph. is planned.



DEVELOPMENT of a novel four-place roadable personal craft named the Travelplane Model 25, which contains a number of interesting design features, is now underway by George H. Hervey, designer, of Roscoe, Cal. Present plans call for thorough wind tunnel tests, construction of a one-place prototype to develop landing gear and other fittings, and an early start on a mockup of the four-seater.

Chief innovation is the proposed use of a single dural tail boom passing through the pusher prop shaft to support the tail surfaces. Power plant is to be a 200-hp. Ranger, alternatively driving the prop and the two main wheels of the tricycle landing gear. Top speed of the Travelplane is to be 135 mph., cruising speed 125 mph., and landing speed 38 mph. Range is planned at 500 mi.

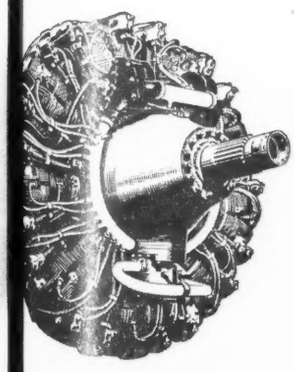
Wing span will be 36 ft., length 26 ft. 8 in., and height 8 ft. 7 in. Fuselage will be 16 ft. long and 6 ft. 6 in. wide. A pilot and 3 passengers, plus 160 lb. of baggage, could be accommodated in standard versions, while a cargo model would carry a pilot plus a 750-lb. payload.

A two-control system is to be used, as will be full-span flaps. Ailerons are to be of a design similar to those used on the Northrop P-61 Black Widow, and it is stated that built-in wing slots will provide further insurance against possibilities of stalls.

For roadability it is stated that the tail assembly and wings will be so constructed that they will be easily detachable in 5–6 min. by one person. These components are designed for stowage in a convenient trailer unit.

Projected Hervey Travelplane Model 25 is planned as a midwing pusher four-place roadable to be powered by a 200-hp. Ranger. Top speed is estimated at 135 mph., and range as 4 hr. at 125-mph. cruising speed. Two-control spinproof, stallproof system is to be incorporated, in addition to scoop-type ailerons like those on Northrop Black Widow.

Silver Service



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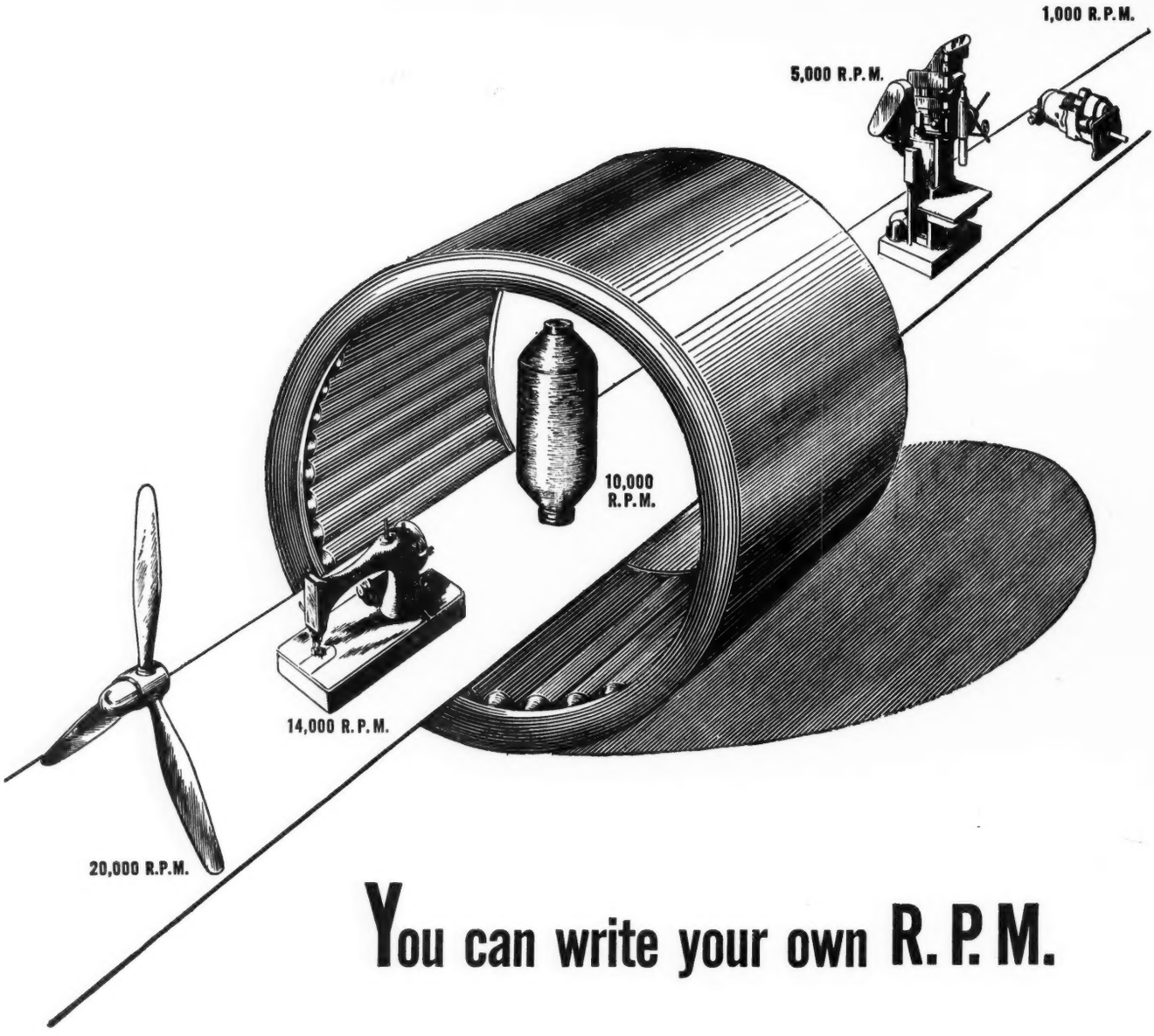

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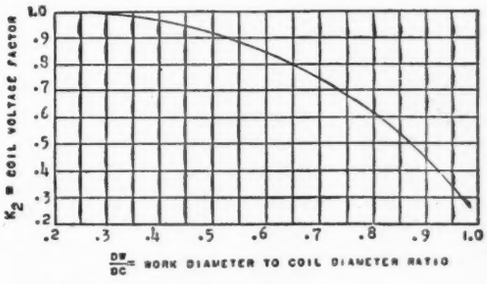
INDUCTION HEATING FORMULAS

COIL VOLTAGE AND CURRENT

$E = H_o\ (2.86 \times 10^{-7}\ NAFK_2)$ volts (rms).

$I = H_o\ (1.43\ \frac{l}{N})$ amperes (rms).

E = coil voltage in volts (rms).
I = coil current in amps. (rms).
H_o = peak magnetizing force (oersteds).
N = number of turns in coil.
A = cross section area in coil (sq. in.).
l = length of coil in inches.
K_2 = coil voltage factor.
F = frequency in cy./sec.



COIL INDUCTANCE

$L = \frac{r^2n^2}{9r + 10l}$ microhenries.

r = mean radius of coil.
n = number of turns,
l = length.

DIELECTRIC HEATING FORMULAS

EFFECTIVE SERIES RESISTANCE OF A CAPACITOR

$R = |X|\ (PF)$ ohms.

$X = \frac{1}{\omega C}$ ohms.

$\omega = 2\pi f$.
C = capacity (farads).
PF = power factor.

DIELECTRIC LOSS FACTOR.

$e'' = (PF) \times e'$.
e'' = loss factor.
PF = power factor.
e' = dielectric constant.

WAVE LENGTH ALONG ELECTRODES

$\lambda = \frac{984}{f\sqrt{e'}}$ (feet).

λ = wave length (feet).
f = frequency Mc/sec.
e' = dielectric constant.

DIELECTRIC HEATING IN AN AIR SPACE

$E_1 = \frac{E}{t}\ \frac{10^{-3}}{1 + \frac{G}{t}e'}$

E_1 = voltage gradient (Kv/inch.)
t = thickness of work.
G = thickness of air space.
E = total voltage across plates (volts).
e' = dielectric constant.

INDUCTION HEATING FORMULAS

POWER INPUT INTO A MAGNETIC CYLINDER

$*P_v = \frac{2.75 \times 10^{-4}}{d}\ \sqrt{\rho f}\ H_o^{3/2}$ (watts/cu. in.)

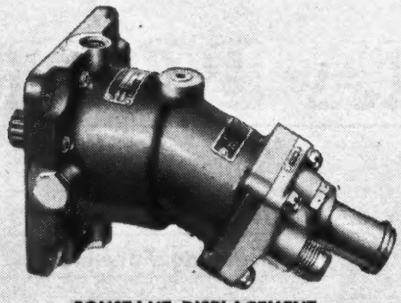
P_v = power density in watts/cu.in.
d = dia. of cylinder in inches.
ρ = resistivity of material in micro-ohms-cms.
f = frequency in cy./sec.
H_o = peak magnetizing force (oersteds).

POWER INPUT INTO A MAGNETIC SLAB

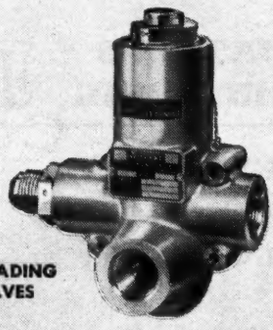
$*P_v = \frac{1.37 \times 10^{-4}}{t}\ \sqrt{\rho f}\ H_o^{3/2}$ (watts cu./in.)

P_v = power density in watts/cu. in.
ρ = resistivity of material in micro-ohms-cms.
f = frequency in cy./sec.
H_o = peak magnetizing force (oersteds).
t = thickness of slab inches.

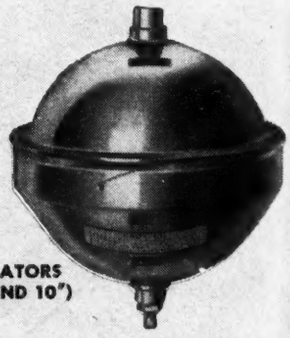
*Formula applicable only if depth of penetration (δ) is less than ½ thickness (t) of slab or less than the wall thickness (t) of a cylinder and if the wall thickness is less than 1/10 of the diameter of the cylinder.



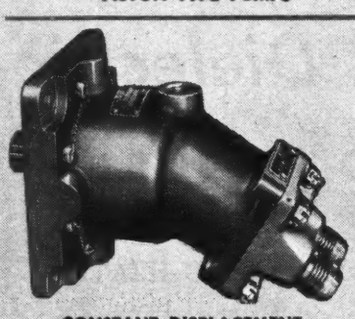
CONSTANT DISPLACEMENT PISTON TYPE PUMPS



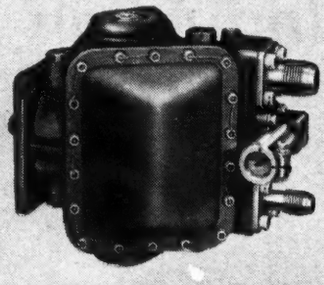
UNLOADING VALVES



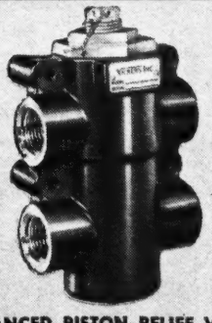
ACCUMULATORS (5", 7½" AND 10")



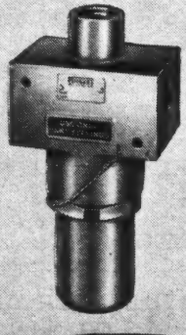
CONSTANT DISPLACEMENT PISTON TYPE MOTORS



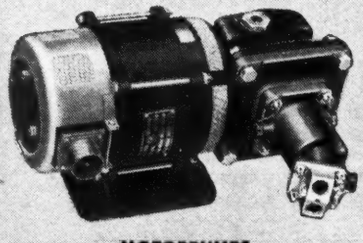
VARIABLE VOLUME PISTON TYPE PUMPS



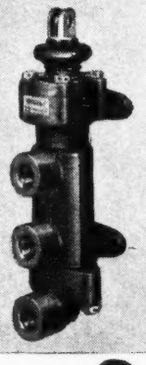
BALANCED PISTON RELIEF VALVES



REDUCING RELIEF VALVES



MOTORPUMPS



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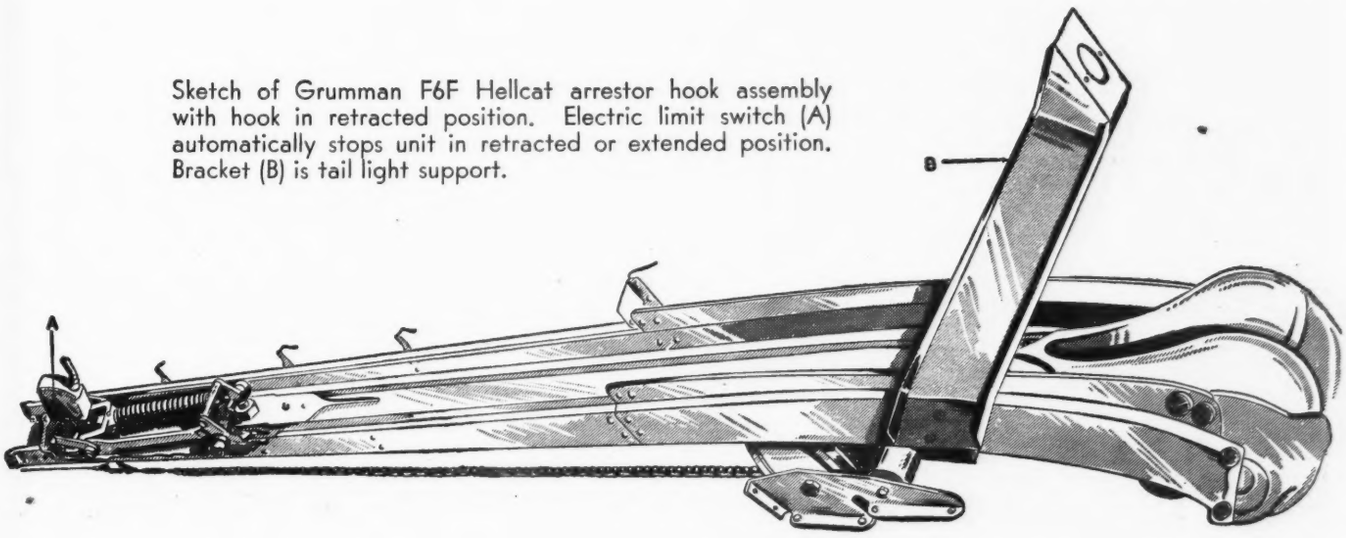
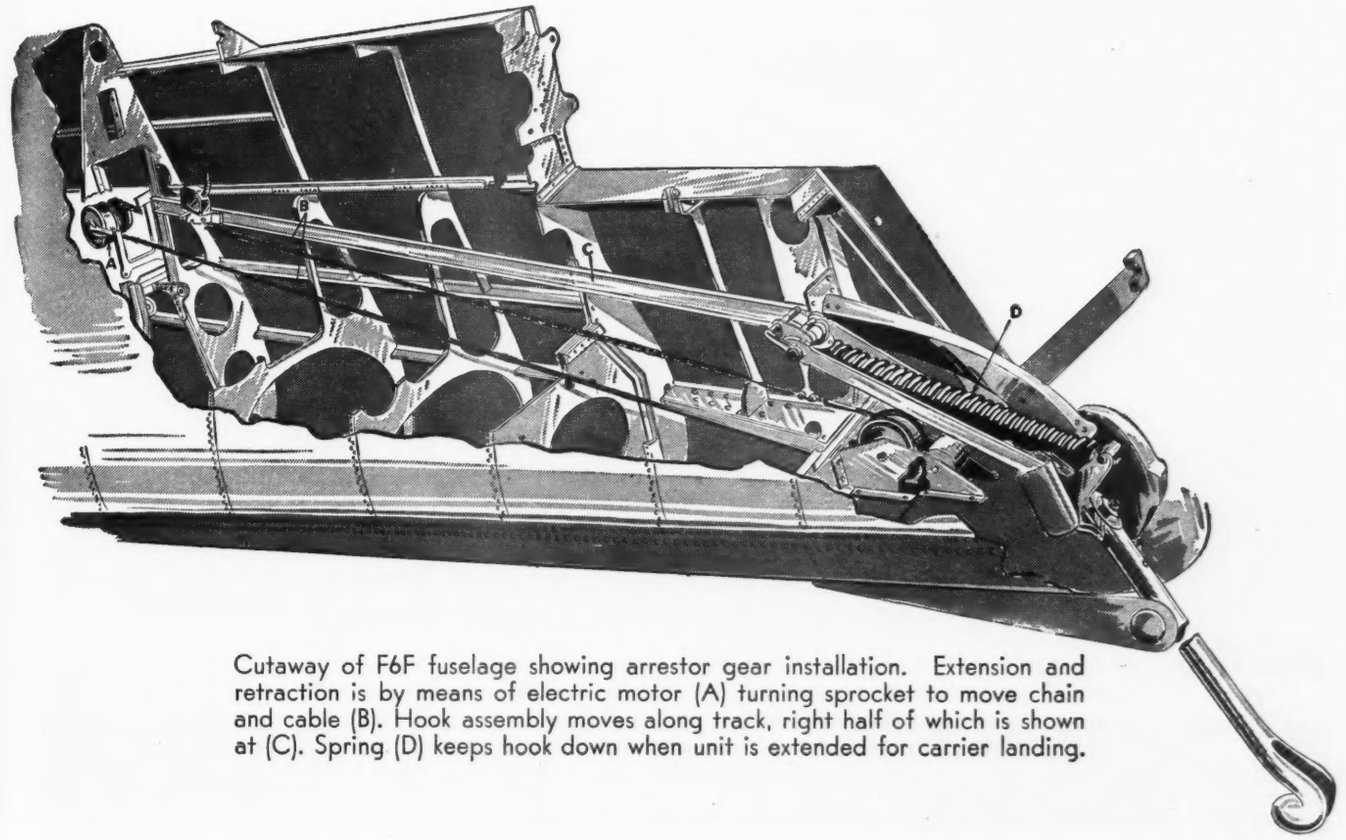
AVIATION'S SKETCHBOOK OF DESIGN DETAIL

Sketch of Grumman F6F Hellcat arrestor hook assembly with hook in retracted position. Electric limit switch (A) automatically stops unit in retracted or extended position. Bracket (B) is tail light support.

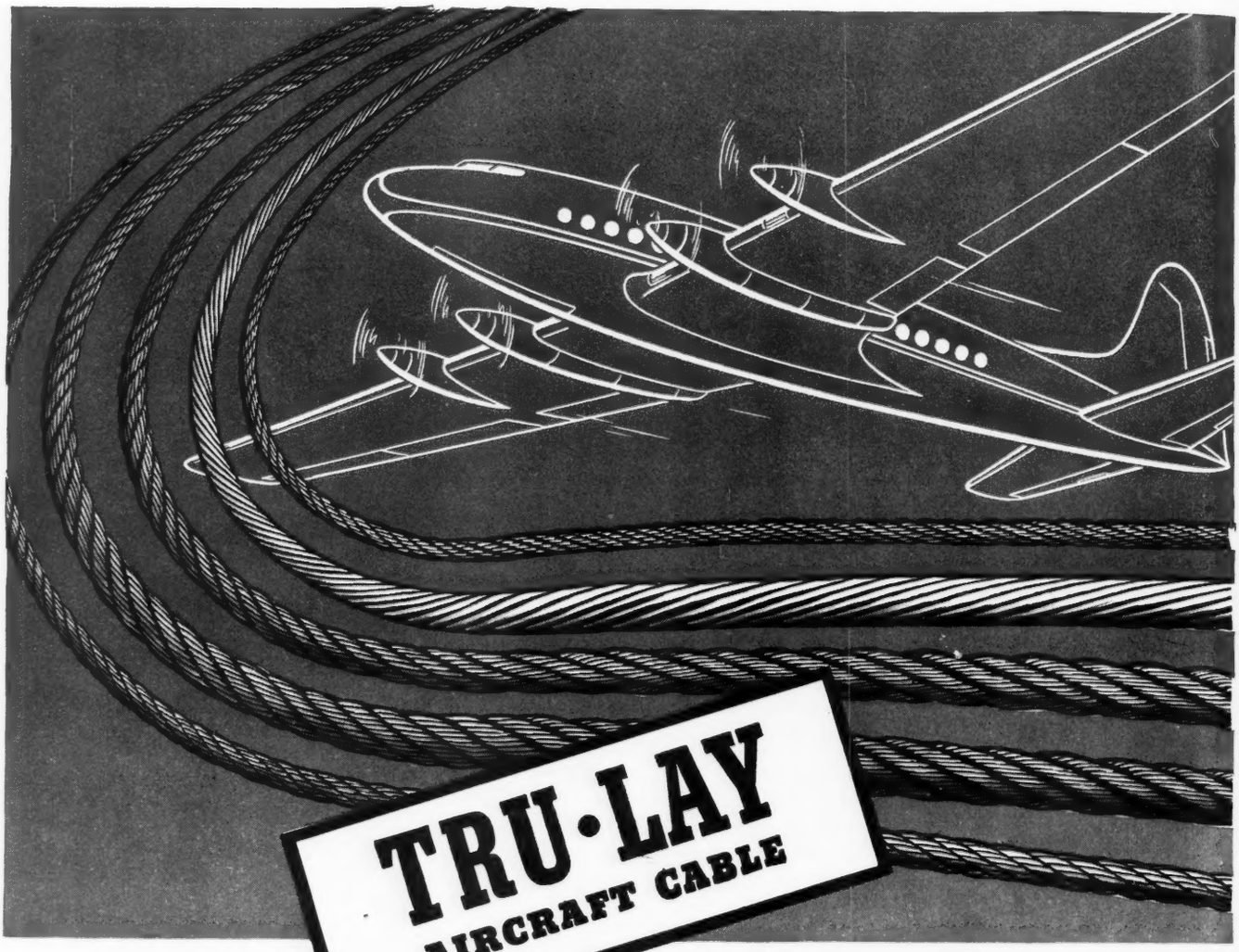




Cutaway of F6F fuselage showing arrestor gear installation. Extension and retraction is by means of electric motor (A) turning sprocket to move chain and cable (B). Hook assembly moves along track, right half of which is shown at (C). Spring (D) keeps hook down when unit is extended for carrier landing.

NAMES ARE IMPORTANT IN AIRCRAFT

—IN CABLES, TOO



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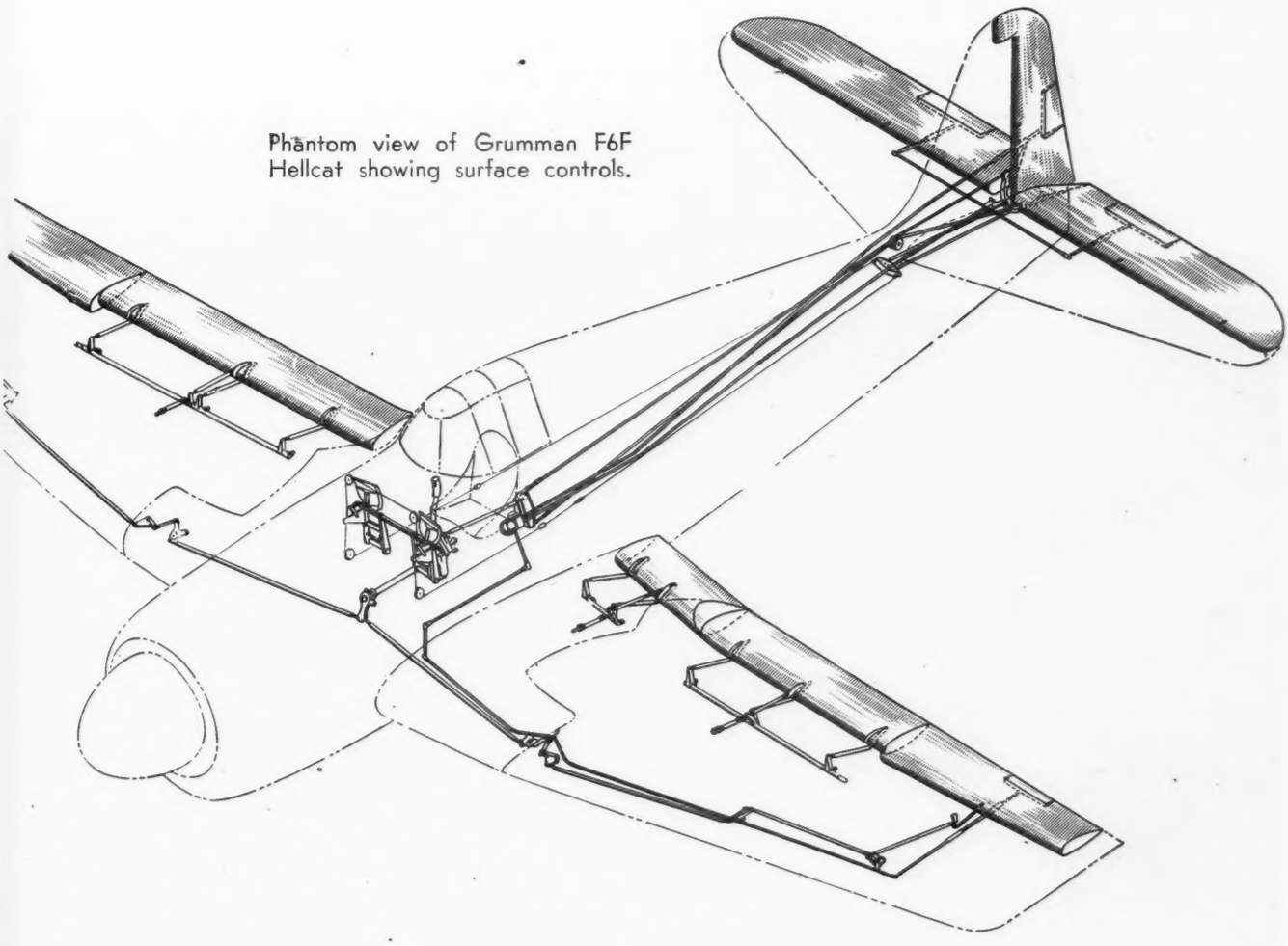

Phantom view of Grumman F6F Hellcat showing surface controls.

Closeup of Republic P-47N Thunderbolt bubble canopy showing transverse frame behind silhouette armor plate and built-up track for opening and closing cockpit. Jettison unit can be seen attached to aft face of frame.

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Provide Distinctive Color Styling

One new DC-4 looks like another DC-4 until distinctive color styling sets it apart, identifies each airline's planes to the knowing eye. Interiors, too, gain individuality through color styling in appointments and finish. Berry Brothers furnish inside and outside finishes to the airlines. Durable, bright Berryloid is used for distinctive exterior trim, to dress interiors in the smooth, appealing color harmonies of modern decorating, and for the protection of assemblies from the weather. On planes coming off the production line and for maintenance and refinishing of planes now in use, you, too, can profitably use Berryloid aircraft finishes.

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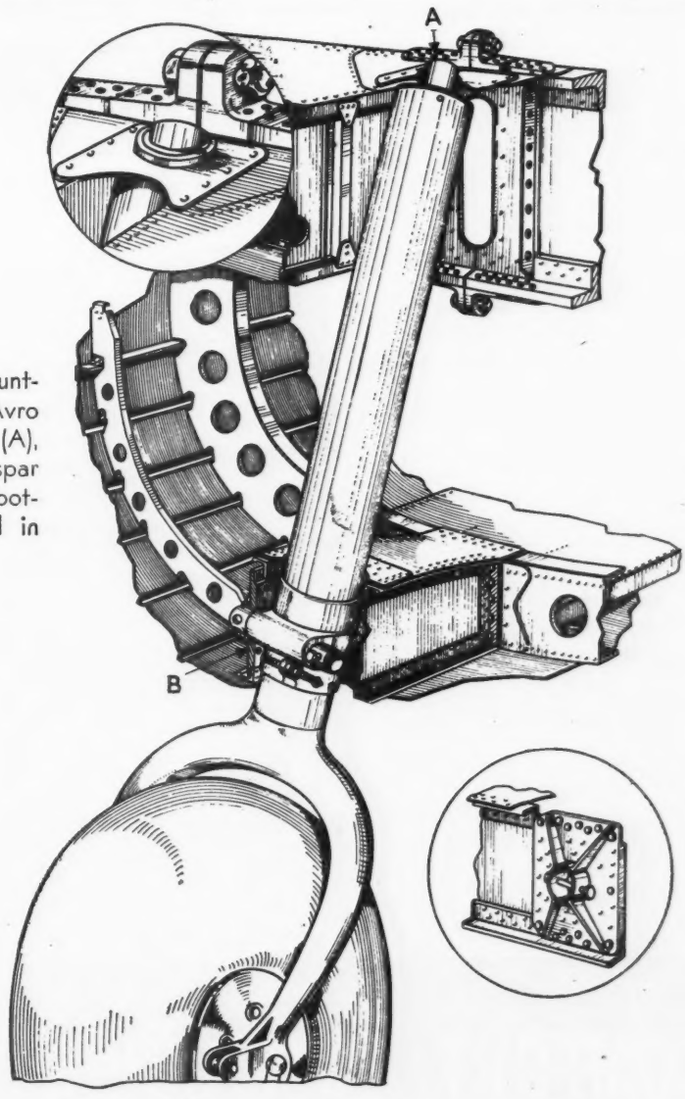
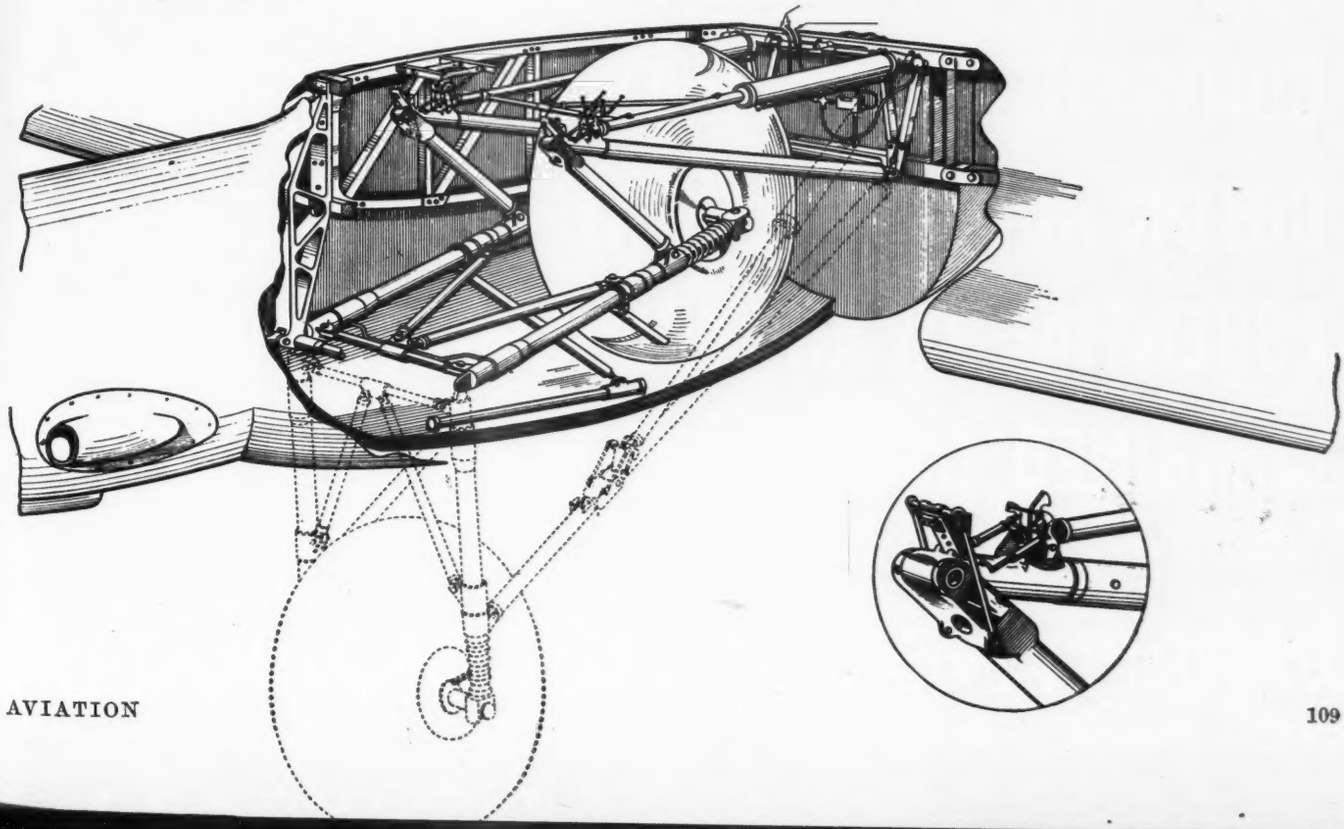


Shown at right are details of mounting non-retractable tail wheel on Avro Lancaster, with top mounting (A), which attaches to stabilizer front spar web, enlarged in circle at top, and bottom mounting point (B) enlarged in circle at lower right.

Phantom view (below) showing method of retracting Lancaster main landing gear, in which wheel is hydraulically pulled aft and up into well between spars behind inboard engine nacelle. Detailed sketch in circle at lower right gives enlarged view of retracting strut locking mechanism.



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WARREN McARTHUR MODEL
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COMFORT, COMPOSURE, CLEANLINESS AND CONVENIENCE, WITH THAT CHARM WHICH COLOR ADDS . . ALL PAY LOAD FACTORS, ESSENTIAL TO AIR TRANSPORT REVENUE, COMBINED IN WARREN McARTHUR SEATS

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SIDE SLIPS

NOT ALL THE STRANGE mind-workings are in this aircraft business, even though it's often accused of having more than its share of screwballs. Added proof just comes in a report that the lower house of the legislature of the fair state of Virginia has passed a bill imposing a tax of 6c a gallon on all aviation gas used in flights over that state—the tax to be imposed whether or not the planes land. But not a thing was said about how they proposed to collect the levy from non-stop flyers.

Maybe they're going to use surplus ack-ack guns—and at the same time get rid of a lot of surplus airplanes.

•

• That "great shipbuilder," according to a newspaper story, "has done it ag'in"—and it pictures him at the wheel of a four-place tricycle gear job developed by a well-known aeronautical engineer. Well, if the correspondent meant getting said shipbuilder's picture in the paper, he was right. But if he meant doing anything in the aircraft industry, we wonder.

Remember back in 1942 when, practically single-handed, he was going to whip the subs by building 5,000 Martin Mars a year? His total production on that deal was a lot of headlines, for Glenn L. Martin was the only company that actually built the plane.

And remember, a little later, when he got $18,000,000 from WPB to produce three big eight-engine wood flying boats, the last of which was to be delivered in Oct. 1944? Fairly quietly, he "withdrew" from that deal, but without delivering even the first craft.

And remember still later when he took over another outfit—again with great fanfare—to whoop up production of a sorely needed Navy fighter plane, and actually got congratulated by an admiral for attaining two-thirds of a cut-back schedule one month? That company's board of directors recently recommended to stockholders that the company be dissolved.

And remember toward the end of the war when he took over a West Coast helicopter and was going to make it available right away for the masses? So far as that craft goes, the masses are still 'copterless, and the young man who designed and built it is on his own again, developing a successor type.

Could it be that what looks like a good airplane—having done its job of producing newspaper pictures and headlines—has received the kiss of death?

• One of our associates answered the phone only to have a feminine voice ask if he knew anything about aviation. With consummate modesty he replied that he'd been in the business some 15 yr., and hoped he'd be able to answer her question.

"Then what," she demanded, "is stratosphere fluid?"

That practically floored him but, undaunted, *he* started asking questions—and finally determined that the young lady had got herself confused over the name of some flossy new bubble-bath stuff.

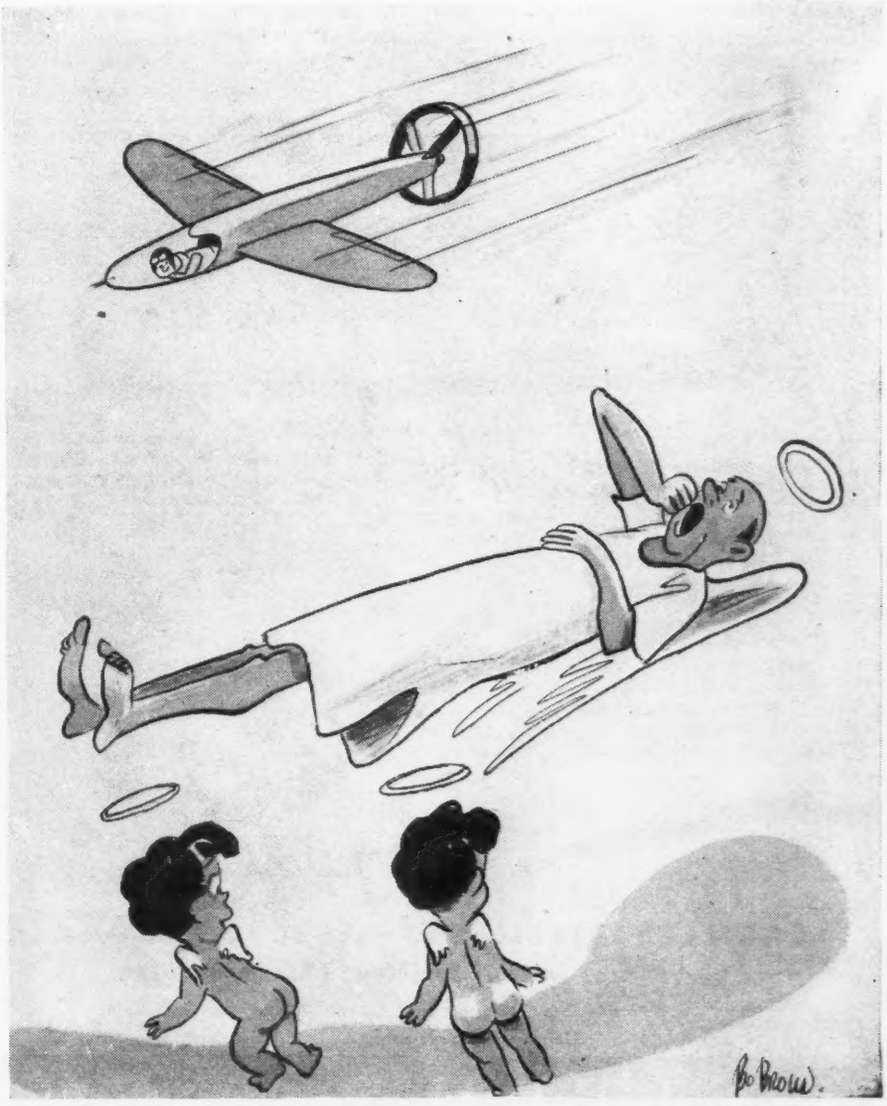
• Hearing that one brought to light several other telephone rings that brightened our days no end. One lad, for instance, just wanted a list giving the name and address of every pilot in the United States. Another wanted, in alphabetical order no less, the name of "every industry which contributed anything used by the aviation industry." And then there was the eager young lady who wanted to know the gross weight of a Boeing B-29.

"A hundred and thirty-two thousand pounds," was the immediate answer.

To which the lass countered, "How many tons is that?"

• House organ of one of the nation's bigger airlines recently featured a photo of a very attractive young lady, with the announcement that she has been appointed procuress of stewardesses.

Will wimmin *never* stop taking over men's jobs?



"Maguire says prone piloting may be efficient but this time of year his favorite position is supine."

Why compromise?

WHEN YOUR PRODUCT DEMANDS SPECIFIC "HARD-TO-GET" PROPERTIES

—Put it up to Alloy Steel!

TODAY, there is no longer any need to be satisfied with "makeshifts" when it comes to steel. No longer need you sacrifice one desirable quality in order to obtain another. The time is past when your entire fabrication processes must be revamped to suit the steel obtainable.

Today, in U·S·S Carilloy Steels, we can place at your disposal a *complete* line of high quality steels. Aircraft Quality Steels—Bearing Steels—Creep Resisting Steels—Nitralloy Steels — Triple-Alloy and Special Analysis Steels, as well as other AISI and S.A.E. Steels. In all grades, in all finishes and treatments—and in the widest range of forms and sizes available anywhere.

In these special purpose steels you can obtain practically any combination of desirable properties to exactly fit your product requirements and your fabricating processes. Here is what approaches a steel user's Utopia—but it also involves a definite hazard. For unless you have *all* the facts*, it is hard to determine what particular steel will give you the best results from the *economic* viewpoint.

In this connection the cooperation of our steel specialists can save you both grief and money. Our metallurgists have been right in the forefront of the metallurgical developments fostered by the war. They have materially assisted in the tremendous advances recently made in steel application — many of which are still comparatively little known. Let them tell you how you can apply this very latest information for the improvement of your operations, for the betterment of your product, and the reduction of its cost.

EVERY SUNDAY EVENING, United States Steel presents *The Theatre Guild on the Air.* American Broadcasting Company coast-to-coast network. Consult your newspaper for time and station.

*Alloy Steel "know how" that pays off!

A rather intricate part in a well-known car overdrive required high case and core hardness to withstand extreme wear and shock loads. Steels to meet such requirements are generally difficult to machine and in this particular part, machining costs were exceptionally high.

When our metallurgists were called in for this job they had just completed a comprehensive survey of all carburizing steels. This led them to recommend the use of another steel, which while considerably more machinable, was superior in physical requirements—and in addition, cost $20.00 per ton less than the original steel used. As each part required 10 lbs. of steel and 1000 parts per day were being produced, the raw steel saving was 10 cents per unit or $100 per day. Figuring on 25 working days per month, 300 days per year, this yearly saving in steel alone amounts to $30,000. And that's not all—10 cents per part was saved in machining, so that the actual economies were doubled—$60,000 per year—and superior physical properties were obtained as well.

U·S·S Carilloy Steels

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THE AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB POWELL, New York E. J. BULBAN, New York

May Not Vote on Unification Until Late Spring Name Generals to Head AAF Reorganization

. . . Detail Navy reserve plan . . . Test Navy aviation in Arctic . . . VHF for private airmen . . . Renew war on weather . . . Fight "opportune" schools . . . Setback seen as fields lag . . . Move to retain CAP . . . NS regulation looms . . . Air museum proposed.

At this writing, unification is still under study by a subcommittee of the Senate Military Affairs Committee. Probably the committee draft of the legislation will not be acted upon by both Houses of Congress until late this spring. President Truman has voiced approval of the unification plan in principle. At any rate, co-equal status of the Air Forces seems certain.

All terms of the measure are still subject to change, in committee, on congressional floors, and in final conference. The Navy continues to attack the merger as "hasty" and as placing too much power in the hands of one man—the proposed over-all cabinet defense secretary.

Statement of General Spaatz as he took over command of the Air Forces (Mar. AVIATION) was: "The air force today is yesterday's air force, but we must keep it in being until we have perfected the air force of tomorrow." Reflecting Gen. Spaatz's policy, Kenneth C. Royall, acting secretary of War, expressed to Congress the opposition of AAF to the creation of a separate air force without the institution of a unified over-all defense command.

International News Service said that Gens. George C. Kenney, George E. Stratemeyer, John Cannon, and Lewis H. Brereton will figure in an early re-organization of AAF, providing a global strategic air force, strong continental air defense command, and streamlined production and training schedules.

Detail Navy Reserve Plan

Navy will train a reserve air force of 28,700 former Navy and Marine personnel who have been discharged since the war's end, and will set up standby units for men who cannot participate in the "ready reserve" because of their work or shortage of facilities.

Ready reserve will consist of 6,100 flyers, 19,800 enlisted personnel, and 2,000 ground officers. None will serve more than 4 yr. Reservists with combat experience will be gradually replaced with younger airmen from the ranks of the approximately 1,000 cadet pilots Navy expects to train each year.

Test Navy Aviation in Arctic

The 45,000-ton aircraft carrier Midway, with the latest airplanes aboard and an escort of three other carriers, has been sent on a test run in Greenland-Labrador waters to determine whether deck-borne aviation can operate successfully in the sub-Arctic. Another group will make further tests next winter. Strategists have pointed out that future military operations might take advantage of the short distances over polar regions.

VHF for Private Airmen

Within two years, private flyers will have all the benefits of very high frequency radio aids, according to a CAA announcement. Airline pilots increasingly use VHF ranges on several airways as airborne equipment is installed. The transition to VHF will be gradual, beneficial, and painless, according to T. P. Wright, CAA Administrator. Existing equipment will retain its value. After several years, all communications along airways and navigation signals will be in the VHF bands, where reception is improved through freedom from static.

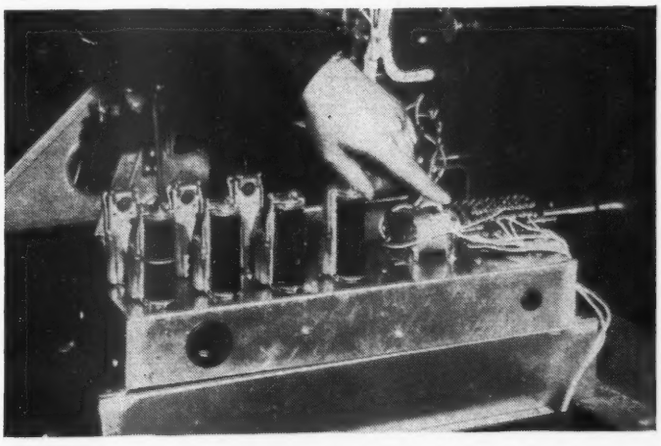
Bureau of Standards announces that radio frequency standards covering the microwave range up to 33,000 meg. per second, or 30,000 times higher than the present broadcast band, have been established, and will open up an enormous number of new channels.

Renew War on Weather

All-Weather Flying Division of ATSC, Wright Field, under command of Col. Ben S. Kelsey, is conducting a scientific battle against aviation's oldest and most difficult problem. Planes equipped with every known weather instrument and device are flown at least once every 6 hr. looking for the worst weather. Whenever any instrument or device proves valuable, a study is made of its proper location and installation in the plane. Ultimate goal of the Division is to "achieve absolute safety-in-flight for all aircraft, both military and commercial, regardless of weather."

Fight "Opportune" Schools

The Veterans Administration started an investigation last month of schools that have sprung up overnight to flight-train ex-servicemen under the G.I. Bill of Rights. VA has no jurisdiction over such schools, but it can ask veterans, receiving benefits for air training, to withdraw from schools judged



PLANE "BRAIN"

Here is robot cranium that actuates AAF's push-button Douglas C-54, a fully automatic craft that can take off, fly a pre-selected course, and land entirely by itself. Pre-set before flight, device shown above controls takeoff of plane, guides its climb to specific altitude, corrects navigational headings, adjusts power settings, retracts or lowers landing gear and flaps, and so forth. AAF recently began extensive flight tests using device at Lockbourne Army Air Base, Ohio. (Press Assn. photo)

COMING UP

Apr. 5-13: National Aviation Show of 1946 (sponsored by Aviators Post 743, American Legion), Grand Central Palace, N. Y. C.
Apr. 8-10: Aero Medical Assn. of U. S. Annual Meeting, Edgewater Beach Hotel, Chicago.
Apr. 12: New England Council Third Aviation Conference, Statler Hotel, Boston.
Apr. 12-15: Sportsman Pilots Assn. Annual Flight to Palm Beach. (Hdq. at Brazilian Court Hotel.)
Apr. 22-24: "Women in Aviation" Conference, Stephens College, Columbus, Mo.
Apr. 23: PICAO Route Service Conference on European air avigation facilities, Paris.
May 7-9: National Assn. of Corrosion Engineers, Annual Meeting and Convention, President Hotel, Kansas City, Mo.
May 13-14: New York State Aviation Council Semi-Annual Meeting, Westchester Country Club, Rye, N. Y.
May 21: PICAO Assembly begins 3-wk. meeting at Montreal.
May 30-June 2: First Postwar Annual New England Light-plane Tour. (Assembles at Hartford, May 29.)
June 1-2: National Air Carnival, Birmingham.
June 2-7: SAE Summer (Semi-Annual) Meeting, French Lick, Ind.
June 8-9: Formal dedication of Eldon, Mo. model airpark.
June 13-14: IAS Light Aircraft Meeting, Rackham Educational Memorial, Detroit.
July 18-21: World's Fair for Aviation, Omaha.
July 19-20: NAA National Convention, Omaha, Neb.
Aug. 15-16: IAS Annual Summer Meeting, Los Angeles.
Aug. 22-24: SAE National West Coast Transportation & Maintenance Meeting, New Washington Hotel, Seattle.
Aug. 31-Sept. 2: National Air Races, Cleveland.
Oct. 3-5: SAE National Aeronautic Meeting & Aircraft Engineering Display, Biltmore Hotel, Los Angeles.
Oct. 14-17: National Aviation Clinic, Oklahoma City.
Oct. 16-17: SAE National Transportation & Maintenance Meeting, Hotel Knickerbocker, Chicago.
Oct. 23-25: Second Annual Arizona Aviation Conference, Phoenix.
Oct. 24: IAS Air Transport Meeting, Statler Hotel, Washington, D. C.
Nov. 7-8: SAE National Fuels & Lubricants Meeting, Mayo Hotel, Tulsa.
Dec. 2-4: SAE National Air Transport Engineering Meeting, Edgewater Beach Hotel, Chicago.
Dec. 17: IAS Wright Brothers Lecture, N. Y. C.

to be just promotion schemes.

Meanwhile established flight schools doubt whether the industry can supply jobs for the thousands of G.I.s who are rushing them. They fear also that training standards will be lowered to the detriment of aviation in general.

Setback Seen as Fields Lag

The Federal aid airport bill was still bogged down in House-Senate conference committee, at this writing, after months of failure to reach an agreement on channeling of Federal funds through state and local governments. Many observers declare the delay is giving aviation a serious setback, and they are again advocating special air committees in both Houses, which would handle aviation legislation more promptly.

CAA is considering minimum requirements for airports of less than Class 1 rating, which requirements would be incorporated in state regulations. Airport engineering companies are complaining that CAA gives too much free service on airport design.

Move to Retain CAP

AAF Chief Spaatz has indicated willingness that the CAP continue a semi-military program of activities along present lines for an indefinite period, and now a committee of 15 State Wing Commanders is drafting a plan, calling for a dues-paying system, which will be submitted to a 48-state meeting. Sen. Claude Pepper has introduced a bill, S. 1907, which would pension CAP members who served after Dec. 7, 1941, in coastal patrol, liaison patrol, tow target units, or courier units.

Air Museum Proposed

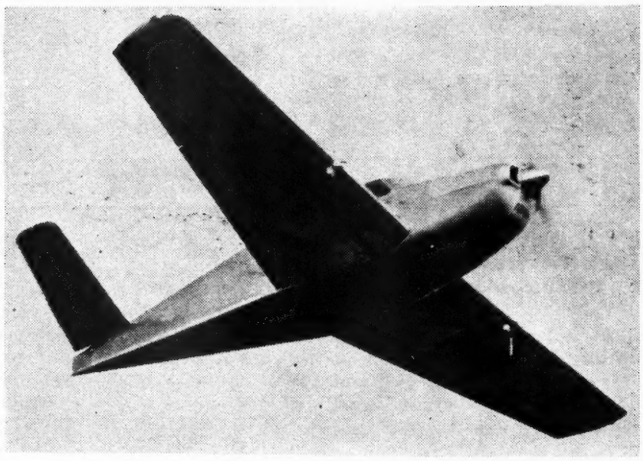
Rep. Jennings Randolph has introduced a bill which would provide for setting up a National Air Museum to house all available mementoes of the craft and art of aviation. The proposal has the support of Gen. Henry H. Arnold, and is also favored by NACA, NAA, and other groups.

Parts-Station Controversy

Proposal by CAA to set up three stations (at Los Angeles, Oklahoma City, and Washington) to store parts and repair its planes, is opposed by the Aeronautical Training Society, Aviation Trades Assn., and other groups, which feel that CAA's project would take business away from them. CAA has asked $900,000 from Congress to build the stations.

NS Regulation Looms

Both safety and economic regulation of non-scheduled air carriers seems imminent. A modified re-draft of Part 42, which deals primarily with safety, will either be circulated or directly considered in an early CAB meeting with the industry. Economic regulation by setting rates will be incorporated in a separate part. Most seriously opposed by operators is the proposed ruling against use of single-engined aircraft at night or in instrument flight conditions.



NEW PERSONAL BEECHCRAFT TAKES WING

Seen in flight is Beech's metal 4-place medium-priced postwar personal plane which is now undergoing accelerated testing. Tagged Model 35, four have been built by hand, two for flight testing, and other two for elaborate static load and fatigue tests. It is stated that simulated rough-air loadings have been imposed up to equivalent of 20,000 flight-hours. All further data is being withheld by Beechcraft until guaranteed figures can be released, but it's stated that 35 has clocked 180-mph. top speed on test course. Note butterfly tail, which dispenses with conventional rudder and fin surfaces.

★ SPOT CHECKING ★

Cleveland National Aircraft Show rolled up record attendance of 204,689 during its ten-day run.

Boeing sent a Model 400 (XF8B-1) fighter to Wright Field for testing by AAF.

Reprints of special contract between Eldon, Mo., and Associated Airports, Inc., for lease and management of Eldon Model Airpark are offered to airport committees and civic leaders by Missouri State Dept. of Resources and Development, State Office Bldg., Jefferson City, Mo. Airpark is to be dedicated June 8-9.

Jet propulsion research lab. being built at Ohio State U. is expected to be completed next month. Officials state lab. will conduct research for Wright Field.

Air Foundation, 400 Union Commerce Bldg., Cleveland, is soliciting contributions to create a $500,000 aviation money chest to help in maintaining American air superiority. It's stated fund will be used to promote scientific research, aid schools by providing scholarships, further public activities in development of air power, encourage development and regulation of public airports, and support charitable institutions helping persons injured in any way by aircraft.

Boeing wind tunnel studies and related research indicate that ultra-high-speed aircraft may one day look somewhat like conventional paper planes thrown about by school boys. Indications are that Boeing is busily engaged on trans-sonic designs.

Fairchild has drafted special plans showing how C-82 Packet may be fitted to transport up to 11 horses in individual stalls.

Optimist Club of Cleveland has awarded first of four scholarships to be given each year to Cleveland CAP cadets. Scholarships entitle recipient to 10 hr. of dual instruction at local airport.

Doman-Frasier Helicopters, 545 Fifth Ave., N.Y.C., new entry in manufacturing field, states it is busy developing a passenger and cargo carrying 'copter for use by suburban shuttle lines. First craft, to be built at Stamford, Conn., is scheduled for flight tests this spring.

Latest AAF helicopter is G & A's XR-9 two-placer, powered by a 135-hp. engine and said to have a 100-mph. top speed. Weight is given as 1,250 lb., and range 3 hr. Craft is fitted with fixed tricycle gear, and single tail boom carries anti-torque rotor.

Parachuting a plane to a safe landing is achievement claimed by Augustus S. Steinthal of N.Y.C. He states that a Taylorcraft, fitted with a 'chute of his invention, was landed intact, following engine failure and after pilot had bailed out. Pilot was quoted as saying he wished he had stayed with plane.

An order totaling $9,000,000 for 35 Martin 303 transports has been signed by UAL. Scheduled for delivery early in '47, pressurized-cabin craft will utilize jet exhaust for added thrust.

More Records: PAA Lockheed Constellation made San Francisco-Hawaii flight in 9 hr. 43 min. . . . Hughes-piloted Constellation flew east-west N.Y.-Culver City, Calif., flight in 10 hr. 15 min. . . . National Airlines' Douglas DC-4 made Miami-Newark hop in 5 hr. 20 min., carrying 46 passengers; then made return flight in 4 hr. 48 min. . . . TWA Constellation flew Shannon, Ire., to Mass. flight in 13½ hr. . . . PCA DC-4 carried record load of 58 passengers, crew of 4, and 4,400 lb. of cargo, from N.Y. to Pittsburgh in 1 hr. 40 min.

New 1,500-mph. super-sonic wind tunnel has been put into operation by NACA. Located at Ames Aero Lab., Moffett Field, Calif., new tunnel is being used to test models of guided missiles and jet- and rocket-propelled planes. Electric motors, totaling 10,000 hp., drive four three-stage compressors at constant 5,350 rpm. Tunnel pressure may be modified from near vacuum to almost three times normal atmospheric pressure. Another super-sonic tunnel nearing completion at same lab. will be able to achieve test speeds of over 2,600 mph.

★ CALLING NAMES ★

Wellwood E. Beall has been named Boeing v.-p., engineering and sales, and assisting him will be **Edward C. Wells, Fred B. Collins,** and **Robert A. Crawford.**

John I. Wagner has been appointed Lockheed's Latin American sales rep.

Ronald S. Gall has been made publicity director for National Airlines, with hq. in Chanin Bldg., N. Y. C.

Lewis A. Rodert has been awarded John Price Weatherill Medal of The Franklin Institute for his aircraft thermal anti-icing work.

Oswald Ryan was appointed vice-chairman of CAB by Pres. Truman.

Northrop appointments: **Richard W. Millar** became chairman of board, and **John W. Myers** was named v.-p. in charge of sales.

Dr. Theodor H. Troller has been named professor of aero engineering at Case School of Applied Science.

George Waite resigned as pres. of Irving Air Chute Co. but continues as a director and in a consulting capacity. **Leslie L. Irvin** succeeded as company's head.

Lawler B. Reeves returned to U. S. Rubber Co. as sales mgr. for airplane tires.

Homer S. Youngs of Douglas was made director of newly-created shipper's research div. of ATA.

W. Art Mankey has been named asst. to pres. of Ryan.

P & W service dept. appointments: **Raymond N. Peck** asst. service mgr.; **Robert G. Bentzinger,** tech. supervisor-service; and **Donald S. Pierce,** field supervisor-service.

Capt. Fred W. Cole has been appointed foreign sales mgr. for General Textile Mills, parachute maker.

Lockheed service appointments: **J. Kenneth Hull,** general service mgr.; **Clayton B. Snow,** mgr. of customer's dept.; **Lyman G. Rice** heads administration; **Roscoe Behan,** supervisor of sales section; **Otto Graff,** mgr. of engineering dept.; **J. W. Lynch,** mgr. of inspection; and **Deane Severns,** mgr. of aircraft repair dept.

CAA appointments: **Ora W. Young,** administrator of 1st region; **Donald R. Harvey,** personnel officer; **William E. Kline,** asst. administrator of federal airways; and **M. Justin Herman** as head of CAA air education.

Adm. William F. Halsey, Jr., famed Pacific Navy leader, has

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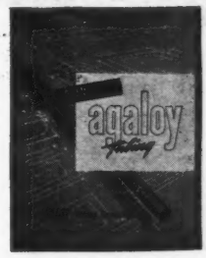

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THE "SKYRANGER," manufactured by Commonwealth Aircraft, Inc., Kansas City and New York, is one of the newer small planes with seats for two side-by-side and dual control. According to its makers, it has many features which render it unusually comfortable and safe for cross-country flying. Fixed type leading edge wing slots of aluminum alloy construction are provided, with the aim of making the ship virtually unspinnable. Top speed is said to be about 115 m. p. h.; cruising speed 103 m. p. h.; cruising range, about 500 miles.

During the war every major combat type of aircraft employed "Lucite" in one or more applications

Another of the new peacetime planes now comes equipped with windows and windshield of crystal-clear, long-lasting "Lucite."

Ask the pilots who guide America's planes what qualities they value most highly in any plane—you'll find "Good Visibility" near the top on any list. In choosing "Lucite" for the "Skyranger," Commonwealth Aircraft, Inc., is assuring excellent visibility . . . is applying a lesson well learned by the designers of America's fighting planes.

With "Lucite" in your enclosures you have crystal clarity in a lightweight plastic that is stable under extremes of sunlight, humidity, temperature. "Lucite" is easily formed into broad curved surfaces, and once formed, *it lasts the life of the plane* under normal service. And "Lucite" costs much less than you may think. Improved manufacturing methods coupled with large demand have brought about *five price reductions.* Medium and greater thicknesses of "Lucite" now cost less than other plastics used for transparent enclosures. Write for free manual on "Lucite" for aircraft designers and engineers. E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Room 224, Arlington, N. J.

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Plastics
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been elected v.-p. in charge of PAA's trans-Pacific services.

J. D. Lewis has been appointed AAA's operating mgr.

George F. Scott has been named Northeast Airlines gen. traffic mgr.; and **Warren H. Smith** gen. sales mgr.

PCA elections: **Louis H. Mueller**, chairman-board of directors; **Robert F. Six**, pres.; **C. C. West, Jr.**, v.-p.; **O. R. Heuter**, v.-p. operations; **Stanley R. Shatto**, v.-p.-engineering and maintenance; **Joseph A. Uhl**, secy.-treas.; and **C. C. West, Jr.**, a member of board. **Ray Johnson** has been promoted to airline's supt. of maintenance; and **Lt. Commdr. John J. Burke, Jr.**, joined legal staff as asst. to v.-p.

UAL appointments: **Paul E. Burbank**, cargo sales mgr.; **R. L. McBrien**, resident rep. for airline at Martin.

Douglas appointments: **Victor E. Bertrandias**, v.-p. and director of foreign sales; **Nat Paschall**, v.-p. and director of domestic commercial sales; **Karl P. Grube**, director of contract requirements; and **John M. Rogers**, head of domestic military sales.

James J. Berlinger has been named Air Cargo Transport's personnel mgr.

Maj. Don S. Gentile and **Maj. John T. Godfrey**, two of AAF's outstanding combat aces, have been named div. directors of sales and service for Globe.

J. T. Dyment, of TCA, received Czowski Gold Medal for '45 from Engineering Institute of Canada for his paper, "The Engineering Selection of an Airline Airplane."

Chester C. Cole has been appointed v.-p. in charge of modification div. of Timm Aircraft.

J. J. O'Donovan, PCA v.-p., has been elected to board of directors of Air Cargo, Inc.

Gen. Carl A. Spaatz, AAF chief, received National Safety Council award for '45 in recognition of AAF's safety record in ground operations. . . . Newly assigned as special asst. to General is **Maj. Gen. Hugh J. Knerr.**

R. H. Puffer, formerly of C-W, has been appointed supt. of Cornell U.'s aero lab.

Walter A. Bowers has been elected v.-p.-treas. of Aireon, radio and equipment maker.

★ CANADIAN NOTES ★

by James Montagnes

Many adaptations have been found for aircraft salvage by government's War Assets Corp., including use of aircraft generators for recharging batteries to supply farm electric power; of wing fuel tanks as water cisterns and domestic fuel oil storage tanks; of aircraft control cables as guy wires for tents; of steering controls for motor boats; of hand compasses and altimeters for prospectors and surveyors in northern bush country; of weather stripping for home use; and of engines and propellers for snowmobiles. . . . War Assets Corp. sold 1,025 craft to Feb. 1946, of which 330 have been sold outside Canada. Including parts, sales have totalled $5,200,000. No surplus lightplanes are being offered at present, only surplus craft now being Cessna Cranes and Boeing Canso flying boats.

Canada's permanent RCAF will consist of 16,100 officers and men, backed by auxiliaries and reserves of equal numbers recruiting for permanent RCAF has now started.

Toronto's Island Airport, municipally-owned, is not to be used by airlines, but by itinerant private and commercial aircraft. Airport is 5 min. from Toronto business section.

Canadian Car & Foundry has acquired principal assets of Noorduyn Norseman Aircraft, Ltd., including all rights for manufacture and sale of Norseman craft. Company will concentrate on Burnelli CBY-3 as well as on Norseman.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Experts used to say termination settlement of aircraft war contracts would be major problem. It turns out to be a lot simpler than expected, though a bit slow at times as regards precise solution.

Wartime manufacturers of all those "fastest airplane(s) in the world" should now take one of each type out of surplus, put the lot on a closed course, and settle the dispute.

Restrictions again are clamped on Army-Navy aircraft contract information, particularly as regards research and development projects. They won't even tell you the dollar value of some contracts.

Cold-weather tests by the Navy's aircraft carrier "Midway" in North Atlantic are important. Air forces of all Northern hemisphere nations could fly "over the top" routes, given enough range. Carrier operations in the Arctic would be limited, depending on time of year.

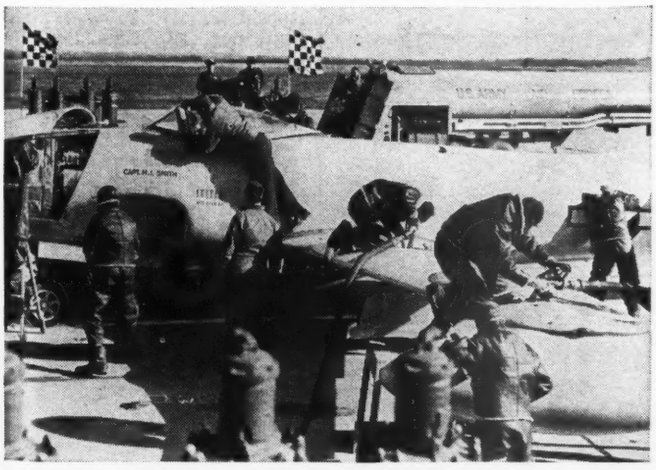
Federal aid airport program mostly concerns small fields. Heart of the transport field expansion is Army-Navy-CAA war-built terminal facilities. Procedure of disposal of surplus to local governments is complicated, accordingly needs study by all interested. Hundreds of un-surfaced auxiliary fields are suitable for private or service operations.

Export of American new and surplus planes is more or less unrestricted. All countries can buy these craft, as agreed at Chicago conference, though State Department can withhold export license when purchaser is uncooperative government or national thereof. At this time Argentina is getting no planes.

Mushroom air schools, set up to capture GI money under the Bill of Rights can't be controlled by Veterans Administration, since they are not in interstate commerce. But VA can stop GI's from patronizing those schools which are found to be of questionable origin and practice.

Many competent government officials feel that unless world politics soothes out soon, this and other countries, by next year, could be back in an another arms production race.

A United Nations leader recently said that fear of instant retaliation with atomic weapons may strongly deter war-makers in future. He could be right, though the same thing was once said of airplanes and turned out to be wrong.



SHOOTING STAR SUPER SERVICE

Another record performance that went almost unnoticed during spectacular Lockheed P-80A cross-country dash was speed with which craft flown by Capts. Smith and Babel were sent back into air when they made refueling stop at Topeka. A picked 17-man Lockheed and AAF service crew, using four fuel trucks connected to a battery of eight high-pressure filters, were spotted at one end of runway as craft taxied in. With pilots remaining in cockpits and jet engines idling at about 4,000 rpm., multi-crew pumped about 600 gal. of kerosene into each plane. At same time, inspectors checked planes. Capt. Smith's plane was back in air in 1 min. 54 sec. after landing, Capt. Babel's in 2 min. 59 sec.

★ OBITUARY ★

Harold R. Neely, CAA administrator for third region. Previously he served organization as airplane and engine inspector and supervising aeronautical inspector. As Army lieutenant in World War I he taught flying.

Dr. Samuel M. Strong, first flight surgeon in U. S. Army. He devised first air ambulance, and was director of American Flying Services Foundation, which aided over 10,000 air candidates to overcome deficiencies.

Lady Grace M. H. Drummond-Hay, British aviatrix and journalist. Before World War II she was one of few women who held military certificate for blind flying. She participated in first trans-Atlantic flight of Graf Zeppelin in '28, craft's round-world flight in '29, and first flight of dirigible Hindenburg to U. S. in '36. She was member of Royal Aero Club, and for many years was pres. of Women's International Assn. of Aeronautics.

William S. Leaycraft, contract terminator for PAA. In earlier days he was v.-p. and treas. of Curtiss and Vultee.

Hans Amundsen, works mgr., Wright Aeronautical Corp. Previous to his 13 yr. with company, he was associated with Sperry Gyroscope and Western Electric.

T. M. Lucas, assoc. mgr. in charge of general sales and service, Wright Aeronautical Corp. Prior to his 18 yr. with this organization, he was affiliated with Franklin Auto Co.

War Department Readies New Air Program; Army Getting Back to Peacetime Procurement

. . . Warplanes at new low . . . SAE continues liaison . . . Personal-plane research weighed by NACA . . . Question of folding wings . . . AIA hails industry status; program is advocated . . . Plant-retention figures . . . Our warplane production doubled runner-up.

Now under preparation by War Department is outline of a program of air power for submission to Congress. This is difficult, in view of rapid obsolescence of existing air weapons, and uncertainties regarding effectiveness of new ones. Another complicating factor is pending legislation for unification of land and sea forces, and co-equality of the air forces.

Meanwhile, Army is getting back to its peacetime aircraft procurement system. Blank-check procurement of experimental types has been eliminated, and negotiated bids and cost-plus-fixed-fee contracts are all but out, in favor of competitive bidding.

These conservative measures have been taken so that, when the Department asks Congress for legislative revision of its procurement program looking toward more liberal terms as a basis of strong air forces, existing practices will not be subject to obstructive criticism.

Chairman Carl Vinson, of the House Naval Affairs Committee, has introduced a bill which would eliminate the 6% profit limit placed on Naval aircraft production by the Vinson-Trammel Act.

Warplanes at New Low

Army and Navy aircraft acceptances in January totaled 161, as compared with 242 in December. The Navy took 71 and the Army 90 of January deliveries. Securities Exchange Commission records show military backlog orders as follows: United Aircraft, $85,482,178, with aircraft and engine sales in fourth quarter of 1945 totaling $68,934,220; Curtiss-Wright, $53,717,903, military sales in fourth quarter, $35,482,498; Thompson Aircraft Products, military backlog, $13,700,000.

SAE Continues Liaison

Society of Automotive Engineers has completed plans to establish a peacetime advisor service for the aircraft industry similar to that provided during war for government and AAF. Based on conception "that problems arising in commercial and civil aviation largely are technical and affect alike the designers, manufacturers, and operators of aeronautical equipment, as well as airline patrons and civilian flyers," the service will assist engineers of involved industries to cooperate on mutual technical problems to accelerate engineering progress of all.

"Our fields of service are confined to proper maintenance and servicing of equipment already in use, and standardization of materials, processes, parts, and equipment in use," Arthur Nutt, SAE Aeronautics Committee Chairman said. An example of proposed liaison projects, SAE's work on standardization, is reviewed in new booklet published by the society, titled "A Challenge Met."

Personal-Plane Research Weighed by NACA

There is now serious consideration by NACA of that often-made proposal that it conduct research on personal-type planes as well as on military and transport types. Dr. Hunsaker, NACA chairman, recently told an appropriations committee in Congress that his group feels responsibility for private-owner type planes.

He said there is serious doubt whether all of the types for sale have sufficient rate and angle of climb for safety, and he suggested it might be possible to test the planes in NACA's full-scale wind tunnel. He felt that performance should be improved by means of aerodynamic refinement, and possibly with high-lift devices, rather than with additional power.

NACA is also considering some development work for lightplanes, such as swivel wheels, noise reduction, and folding wings—provided the industry does not raise any objections, as it has on previous occasions.

Question of Folding Wings

Moot point whether personal-type craft should be equipped with folding wings to save storage space and cost has been posed again by John Geisse, assistant to the CAA Administrator in charge of private flying development. Mr. Geisse estimates that the cost of folding wings might be between $100 and $250 per plane, and that the saving in hangar space might be $150 or more per year—or $1,300 to $1,800 in 10 yr. Fred Weick, engineer with Engineering Research Corp., commented that pilots might not use the fold feature unless it had push-button simplicity.

AIA Hails Industry Status; Program is Advocated

Aircraft Industries Assn. annual report emphasizes success of the industry in restricting its profits and at same time accumulating sufficient reserves to carry it through the conversion period and continue to provide a reasonable level of employment. Being advocated are: (1) A continuing program of research and of development procurement, service test of civil and military aircraft, and of guided missiles; (2) sound procurement legislation; (3) encouragement of competitive development through incentives such as patents and profits; and (4) expansion of transport and private flying through modification of regulations, and increasing landing facilities.

Plant-Retention Figures

As of Feb. 1, only five of 49 aircraft plants sold had been acquired by makers of aviation products. Four of these were bought by their wartime operators. And of 16 plants leased, only 5 have been occupied by aviation companies who occupied them in wartime.

Our Warplane Production Doubled Runner-Up

Marshal Stalin's disclosure of Russia's three-year wartime aircraft production — 120,000 craft—permits for the first time a compilation of world aircraft production for the war, points out E. E. Wilson, AIA chairman.

"It is now an established fact," states Mr. Wilson, "that American industry, starting from scratch, produced more planes than the next two largest producing nations combined. Our output was virtually double that of our nearest competitor." In the following AIA table, outputs are given in thousands.

	'42	'43	'44	Total
Russia	..	..	..	120*
Britain...	23	26	29	79
Germany.	15	25	40	80
Japan ...	9	16	29	53
U. S.	49	85	96	230

*Marshal Stalin said Russian production averaged "about 40,000 planes per year" in three years considered.

LINDBERGH FIELD FROM ALOFT

Here's first aerial view to be published since war of Lindbergh Field, San Diego, showing layouts of Convair (right) and Ryan (near center). New 8,700-ft. main runway, jointly financed by Convair and Navy, will be used in flight testing Convair XC-99 now being completed at field. Near top of photo is seen $23,000,000 Convair Plant 2, now being returned to government. At lower right-hand corner may be noted some buildings of Solar Aircraft, while large seaplane base at lower center is Coast Guard airbase. Parked about field are Convair PBY's, PB2Y's, PB4Y's RY-3s, and B-24's.

★ INDUSTRY MEMOS ★

Douglas' foreign orders for C-54s: Air France 15; Swedish Airlines 6; Australian National Airlines 4; Dutch Airlines 4; Belgian Airlines 4; South African Airlines 4; Spanish Iberia 3; Norwegian Airline 2; Danish Airline 2 . . . Company's commercial backlog is about $100,000,000, military orders about $50,000,000.

Beech made first overseas flight delivery of Beech 18 to Misr Airwork, Egyptian airline. Craft were flown over by way of South Atlantic.

Assembly line shorts: Aeronca is turning out 17 Champions daily and reports over $6,000,000 worth of orders for '46 . . . Piper estimates its orders as totalling over 63,000 planes . . . Luscombe company is currently employing about 700 people. . . . First Fairchild F-24 built by Texas Eng. & Mfg. Co., Dallas, rolled off line.

Matson Lines, Oakland Municipal Airport, Calif., has orders to convert a number of Douglas C-54s for Netherlands Purchasing Commission.

Continental began production and shipments of postwar hydraulically controllable pitch prop for personal planes of up to 200 hp. Company states new prop shortens takeoff run and ups initial rate of climb.

Publications: Fourth and final edition of "Catalog of Aluminum Alloy Extrusion Dies," issued by National Aircraft Standards Committee of AIA, is now available from printer, John S. Swift Co., 455 W. 30th St., N.Y.C. Book gives die numbers and dimensional data on 10,621 dies developed during war for aircraft industry . . . "Recommended Practices for Resistance Welding," by American Welding Society, is 47-page booklet compiling recommended practices for spot and seam welding of low-carbon, stainless and hardenable steels, nickel, monel, and iconel; also projection-welding of low carbon and stainless steels, flash-butt welding low and medium forging strength steels, and standard methods for testing resistance welds. Priced at 50¢, copies can be had from AWS, 33 W. 39th St., N.Y. 18, N.Y.

Boeing contracted with Northwest Airlines for early '47 deliveries of ten Stratocruisers at $15,000,000, and also with Swedish Intercontinental Airlines (SILA) for four of craft at $6,000,000 . . . In addition, Boeing has a military backlog put at $50,000,000.

Lockheed has orders for 107 Constellations at $79,000,000, plus $46,300,000 worth of Constitutions and Saturns . . . Military backlog is about $137,000,000.

Taylorcraft is adding new assembly wing to present plant, giving 200,000 sq. ft. more floor space.

★ FOR THE RECORD ★

Aero Counsellors, Inc., is new consultant company on aviation matters. Formed by O. J. Whitney, H. P. Bingham, Jr., and Archibald M. Brown, Jr., location is 40 Wall St., N. Y. C. (5).

An organization of early 'copter pilots — "Twirly Birds" — has been formed with following officers; Igor Sikorsky, pres.; Charles L. Morris, v.-p.; C. A. Boeller, secy.; and D. D. Viner, treas. To qualify for entry, applicants must have made solo helicopter flight prior to V-J Day. Organization's address is Grassy Hill Rd., Orange, Conn.

Pacific Airmotive acquired exclusive distributorship for B. F. Goodrich and Weatherhead Co. products in Western U. S. and Alaska.

Institute of Air Transportation has been newly chartered as a non-profit organization to coordinate nationwide system of efficient air transportation on part of nation's cargo contract carriers, passenger charter operators, and non-scheduled operators. National hq. is at 500 Fifth Ave., N. Y. C.

Charles H. Babb Co. acquired former EAL hangar at Newark Airport, N. J., for servicing and reconditioning aircraft.

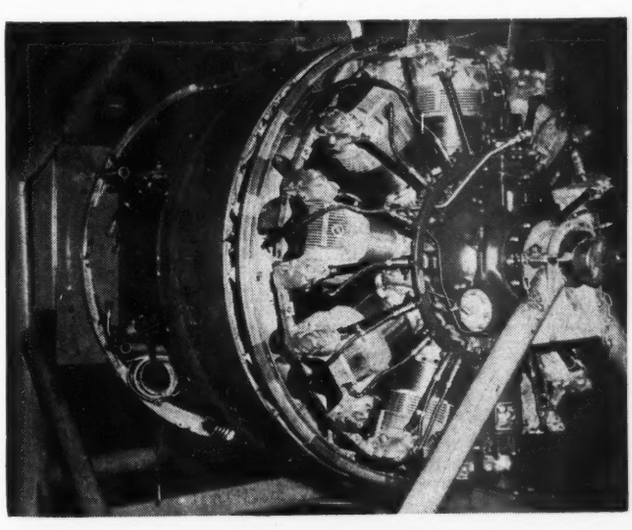
Goble Aircraft Specialities, 135-06 Northern Blvd., Flushing, N. Y., has been formed to take on manufacturing and sales rights to new devices pertaining to aircraft operation, servicing, and maintenance.

★ CAA TYPE APPROVALS ★

Aircraft: Commonwealth 185, ATC 729; Douglas DC-3C-R-1830-90C, ATC 669; Stinson L-5, ATC 764; Taylorcraft BC12-D, ATC 696. Airworthiness certificates: Noorduyn UC-64, 2-578; North American AT-6, 2-575; Canadian Vickers Stranraer, 2-574; Stearman B, 2-580.

Engines: Lycoming 0-235-C, ATC 223; P&W Wasp Jr. B-5, ATC 123; Wright Cyclone 73609HD1, 2, 3, 4, ATC 243; Wright Cyclone 702C9GC4, 5, 6, ATC 219.

Propellers: Continetal PA-108A, ATC 831; Flottorp 74C, ATC 754; Sensenich 72CK, ATC 691; 74RR, ATC 789; 102CA, ATC 546; 86CB, ATC 654; 86BB, ATC 586; 85LYA, ATC 586; 44K15005, ATC 586; 74RA, Canadian Car & Foundry P44E500, ATC 835.



CYCLONE AND NACELLE NOW "PACKAGED"

New Wright-Rohr power unit, seen here mounted on handy dolly, is claimed to be first American power egg, a unit that features quick, complete engine mounting within 20 min., accessibility, and new light weight. Consisting of Wright 9HD Cyclone fitted to Rohr Aircraft mount, installation is undergoing flight testing in a Douglas DC-4 for commercial approval. It is stated that DC-4 fitted thus is 1,150 lb. lighter than standard model, at empty weight. Rohr nacelles are priced at $35,000 per DC-4 in 20-plane sets.

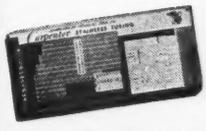
Wouldn't You Like This Kind of Help on *Stainless Tubing* Jobs!

Here is how your engineering ability and Carpenter's experience with Stainless Tubing can be combined to lick the toughest kind of design-engineering problems.

The problem in producing this radio antenna was one of securing a tube that could be easily swaged and flattened and at the same time maintain sufficient rigidity.

When the problem was handed over to us, three samples of Carpenter Type 304 Stainless Tubing (⅜" x 20 ga.) were submitted, each with a different degree of hardness and ductility. Tests showed that one of the samples should give perfect performance. And the fabricating results were excellent, too. The tubing was ductile enough to be swaged to 3/16" in a section 24" long and flattened (inset in photo) on the opposite end.

When *you* want any kind of help with a Stainless Tubing problem, call on Carpenter.



Ask For This New Slide Chart of Technical Data

In convenient form, this slide chart gives you useful information on:

Mass Velocity Constants (V_m)
Velocity Constants (V_l)
Cross Sectional Areas of Tubes
Sq. Ft. Surface per Lineal Foot of Tube
Physical Properties of Stainless Tubing

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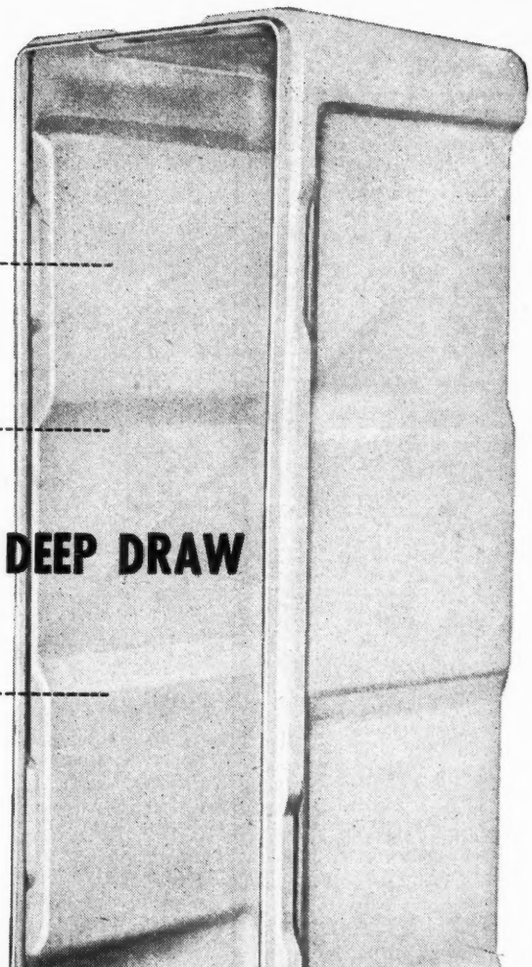

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1. You can effect greater deformation without danger of fracture. Reductions up to 65% in one operation are common.
2. Less power is needed because yield strength is lowered in this temperature range.
3. Time and money are saved through elimination of interstage annealing and multiple press operations.
4. Tool costs are materially reduced because no interstage dies are needed.
5. Springback may be eliminated, so that the part can be drawn to a final fit in one stroke.

Consider what this can mean in terms of production speed and economy. Then add to that the outstanding feature of magnesium alloys—their feather-light weight, their extremely high ratio of strength to weight—and you see how better airplanes, better truck and bus bodies can be made at a substantial saving in the cost of time, labor and tools.

Revere light metal products include magnesium sheet and plate, rod and bar, tube, extruded shapes, and forgings in all standard wrought alloys, as well as aluminum alloy tube, extruded shapes and forgings. A Revere Technical Advisor will gladly consult with you about the application of these products to your business. Get in touch with Revere.

Weighing only 5 lbs., this box 29" long, 11" wide and $10\frac{3}{4}$" deep was made of Revere magnesium alloy 0.081" sheet by Brooks and Perkins, manufacturing engineers, 2457 Woodward Avenue, Detroit, Mich. Produced in *one* draw on a 200-ton hydraulic press at a temperature of 550°F. An additional operation formed the shoulder at the top to receive the lid. Made to carry military rockets, these deep-drawn magnesium boxes suggest how readily magnesium can be used to lighten the weight of bus and truck body parts as well as numberless other products.

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• • •

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Conference Sets Interim Atlantic Fares; Standard Rates Await New Data on Costs

. . . ATA judges legislation . . . Negotiate on pilot pay . . . Push shipline interests . . . Lightning menace is targeted . . . Test all-weather airline operation

Interim fare rates for air travel across the Atlantic were established at recent N. Y. C. Atlantic Traffic Conference of International Air Traffic Assn. and sent to CAB in Washington and to the other governments involved. Rates agreed upon by 40 representatives from U. S., Canada, Britain, France, The Netherlands, and Scandinavia, were only slightly less than present ones, but it was stressed that not enough knowledge of costs of trans-Atlantic operations is as yet available to substantiate any great reductions.

At any rate, fares agreed upon are not to extend beyond July 31 of this year, and in the meantime a standing committee of cost experts is at work figuring operating costs for presentation at the next conference in June.

CAB approved participation of U. S. carriers in conference, since disapproval at this time, CAB stated, would have deprived this government of the present chance to exercise jurisdiction over international routes. Approval extends only to Feb. 28, 1947, and does not cover any actions that may be taken during the course of such conferences.

An express rate of 0.8% of the passenger fare per kilo (2.2 lb.) was also agreed upon at the conference, and free baggage allowance was increased from 25 to 30 kilos (from 55 to 66 lb.).

The recent Anglo-U. S. Bermuda air transport agreement (page 123 Mar. AVIATION) was concluded as an Executive measure, but some anti-Administration members of Congress are demanding that it be handled as a treaty, which would require Senate ratification. This could involve the agreement as a political trading point when the proposed British loan is tackled.

ATA Judges Legislation

The Air Transport Assn. has formed a Government Affairs Committee as successor to its former State Relations Committee. The new committee, headed by E. Smythe Gambrell, EAL general counsel, will handle matters of local, state, and federal legislation dealing with air transport, keeping track of all bills, and making proposals from ATA's point of view. Emory S. Land, now ATA president, issued the order. O. M. Mosier, v.-p. of AA, is committee vice chairman for the new program.

Negotiate On Pilot Pay

Air Line Pilots Assn. demands for a 50% increase in pay for flying 4-engined equipment is being negotiated by ALPA and the newly-created airlines committee on wages, through the offices of the National Railway Mediation Board. ALPA at first declined the deal with the airlines committee, which has power of attorney from 13 airlines to negotiate for each or all on wages and working conditions. But when CAB formally approved the airlines committee, and when the Mediation Board found the procedure proper, ALPA unwillingly joined in bargaining.

Push Shipline Interests

The Sea-Air Committee, affiliated with the National Federation of American Shipping, has been formed to advance the interests of shiplines in their applications before CAB for certificates to operate airlines. Sea-Air issued a statement quoting Emory S. Land, now president of ATA, as advocating air privileges for surface shipping, while he was chairman of the Maritime Commission. A number of the leading shipping concerns have filed applications. The law permits CAB to certificate them only if the public interest requires. The late President Roosevelt is said on good authority to have written a letter in which he firmly opposed air auxiliary for the shiplines.

Lightning Menace Targeted

Testifying in Congress on a bill which would authorize special research into lightning as a menace to aviation, S. G. Tipton, ATA general counsel, said that thunderstorms have cost the government millions of dollars in equipment. Mr. Tipton said that though lightning is the most serious hazard for civilian and military pilots, they know nothing about it. He declared his hearty support of the proposed study.

Test All-Weather Operation

Army Air Forces will establish an experimental all-weather airline, using equipment selected by a committee of technicians headed by Col. Ben S. Kelsey of Wright Field. The announcement came from Maj. Gen. Curtis E. LeMay, deputy chief of air staff for research and development, after a week-long meeting of 300 experts on all-weather flying.

Some officials of CAA fear that too-rapid promotion of radar for instrument flight may slow the completion and use of the present local-range system. Radar for traffic control around airports was given special consideration at the meeting.

★ CROSS COUNTRY ★

TWA: New 3-hr. non-stop N. Y.-Chicago service 3-times daily was inaugurated using Lockheed Constellations . . . One departure weekly from Phila. to Paris was also announced.

UAL: Airline is equipping Douglas DC-4s with Sperry electronic automatic pilots . . . Inaugurated was daily non-stop cross-country DC-4 flights . . . Airline will soon start scheduled service to Catalina Island from Los Angeles.

Air Express Div. of REA estimates that its combined transportation facilities cover almost 300,000 mi. in U.S. Shipments totalled new high of 40,745,000 lb. in '45, against 34,276,000 lb. in '44. Revenue last year bettered $13,500,000.

EAL: Airline signed 20-yr. lease on former Convair plant in Miami, to be used as maintenance and operations base . . . Additional daily service was started between Boston and Atlanta, via Newark, N.J.-N.Y., Phila., and Washington, D.C., thus increasing number of daily round trips between Newark-N.Y. and Atlanta to 10, and between Newark-N.Y. and Boston to 8 . . . Seventh daily round-trip between Chicago and Miami was started, also fourth daily Detroit-Miami round trip . . . Company plans addition of 20 Douglas DC-4s by late Spring.

AA started weekly flights to Amsterdam from N.Y.C., with connecting services going to Antwerp, Berlin, Brussels, Paris, Rome, and Vienna.

Air Cargo Transport is building commercial air cargo warehouse at Newark Airport, N.J. . . . Airline cut cargo rates from 30¢ a ton-mile to 20¢.

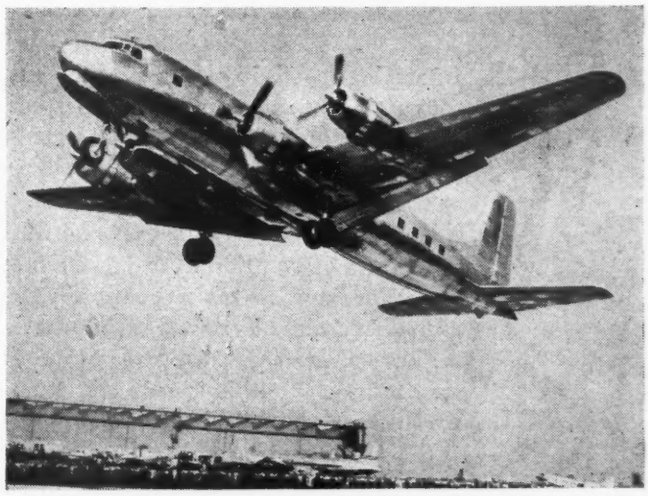
Delta Air Lines introduced DC-4 Chicago-Miami service, clipping 86 min. off previous schedules.

CAL offered new passenger fares, featuring cuts as high as 19%.

Restoration of Oakland Airport, Calif., to full commercial status is underway, with building improvements and landing fees approved by City's Board of Port Commissioners.

New Airlines: American Air Express Corp., 522 Fifth Ave., N.Y.C., solely for transcontinental express and cargo, using Douglas DC-3s . . . GI Aerial Freight Lines, Calif., non-scheduled carrying of passengers or cargo, using surplus Douglas C-47s . . . Claude Neon Lights, 545 Fifth Ave., N.Y.C., organized Challenger Airlines to operate passenger charter service, with Utah as base.

PAA: Preparatory to starting daily service to Bermuda, airline is doubling number of present flights. Craft are Lockheed Constellations . . . Company announced it had to postpone indefinitely planned daily service between N.Y. and France, because latter government did not approve PAA's low fare rate.



DOUGLAS DC-6 PROTOTYPE MAKES FIRST HOP

Military counterpart of DC-6, Douglas XC-112, takes off on its maiden flight with Ben O. Howard at controls. As successors to famed DC-4, commercial versions of this craft are slated for airline delivery in next few months. Featuring a pressurized cabin, DC-6 will seat 56-68 passengers, and will be fitted with 2,100-hp. P&W Double Wasp engines turning 13-ft. Curtiss reversible pitch props. Standard gross weight is given as 81,500 lb. and top speed as over 300 mph. Other highlights: Thermal anti-icing of wings, tail, and windshield; air-to-ground telephone hookup; and floors covered with foam rubber. Orders are on hand from AA, PAA, UAL, WAL, National Airlines, and Australian National Airways. (Press Assn. photo)

100,000 R.P.M.

Midget 3 lb. Turbine Cools Air 140° F.

Operating speeds in excess of 100,000 R.P.M. create air velocities up to 800 miles per hour in the new midget 3 lb. AiResearch Expansion Refrigeration Turbine, which is revolutionizing the aircraft airconditioning field.

This turbine—weighing only one-fiftieth as much as a conventional refrigeration system of similar capacity—makes possible *high speed, pressurized* flight by post-war commercial and military aircraft, because streamlining necessary to reach today's speeds leaves no room for ordinary electrical cooling equipment.

It uses only air as a refrigerating medium, and it requires no additional source of power. It has a *single moving* part...and is the only mechanical unit with a self-contained lubrication system ever to operate at such high rotative speed in a fully maneuverable airplane.

Produced after nearly five years of engineering research, the midget cooling turbine is another AiResearch "first".

AiResearch cooling turbines—ranging from the 3 lb. midget up to more powerful slower speed units approximately 18 inches in diameter—are being built for such planes as the Lockheed Constellation and P-80; Douglas DC-6 and B-43; Consolidated Vultee P-81 and B-46; North American B-45 and Boeing C-97. The AiResearch background of engineering skill and research is available to help solve *your* Air Control problems. Write to AiResearch Manufacturing Company, Los Angeles 45, California.

AiResearch — manufacturers of AIR CONTROL equipment • Cabin Pressure Regulating Systems • Engine Oil Cooling Systems • Supercharger Aftercooling Systems • Temperature Control Systems • Engine Intercooling Systems • Automatic Exit Flap Control Systems

AiResearch
DIVISION OF
THE GARRETT CORPORATION

★ INTERNATIONAL BRIEFS ★

ENGLAND—Britain's bid for capturing feederliner market is a four-engined propjet plane carrying 24 passengers in a pressurized cabin. It will have a 1,035-mi. range and 276-mph. cruising speed, according to an official MAP statement.

Cunliffe-Owen has announced the Concordia, a 10-passenger feederplane, powered by two 500-hp. Alvins. Grossing 11,000 lb., and having a 3,900-lb. payload, cruising speed at 60% power is estimated at 190 mph. A mockup has been finished and prototype is expected to fly this year.

Specifications of the Airspeed Ambassador have now been changed to include propjets instead of Bristol Centaurus engines. Prototype is expected to fly next September.

Ministry of Aircraft Production announced that Power Jets, Ltd., acquired by Government in 1944 (see page 218, Sept. 1944 Aviation) will become national research foundation for gas turbines without private interests. Air Commodore Frank Whittle resigned immediately after this announcement in disagreement over policies.

Orders for commercial aircraft to be completed this year include 37 Yorks, 20 Tudor Is, 79 Tudor IIs, 108 Vikings, 13 Bristol Wayfairers, and 12 Bristol Freighters in addition to 5 Constellations and some military conversions.

Twelve Short Solents have been ordered for British airlines. Solent is a four-engined flying boat powered by 1,675-hp. Hercules, with a gross wt. of 750,000 lb. It carries 24 to 36 passengers at a top speed of 236 mph.

HOLLAND—Royal Netherlands Navy, having ordered a substantial number of Fairey Firefly two-seat fighters, recently took delivery of first six.

Private reports from Holland say Henry "Curley" Veenendaal was recently named managing director of KLM, shortly after a celebration of his 25th yr. with company.

BELGIUM—SABENA, the official Belgian airline, now has 9 DC-3s, 4 DC-4s and 3 deHavilland Doves on order for its expanding services in Europe and to Belgian Congo. Present routes are being operated by C-47s and Lodestars.

SWEDEN—The Swedish Government has placed an order with deHavilland for more than $12,000,000 worth of Vampire jet fighters and engines.

ITALY—Similar to P-82 Twin Mustang was Savoia Marchetti SM-92, developed under Nazi auspices. Powered by two 1,250-hp. Fiat engines and carrying a pilot in one fuselage section only, top speed was 413 mph. Armament consisted of three 12.7 mm. machine guns, one of which was located in a small nacelle on stabilizer and shot to rear.

DENMARK—The Danish Government has suspended sale of tickets on American Airlines' services because of the lack of U. S. dollars. Offers by AOA to accept Danish Crowns for its tickets in order to obtain funds for maintenance of its Danish offices have so far not been accepted.

RUMANIA—Lares, original Rumanian airline, has been dissolved by Government order under Russian pressure, and all assets have been taken over by Russo-Rumanian Air Transport Co., known as Tars.

PHILIPPINES—Far East Air Transport has started regular service between Manila and Shanghai with C-47s. Services to Singapore, Sourabaya, and Darwin are expected to start this summer.

AUSTRALIA—Cherry growers are discussing possibilities of airfreighting their crops to England via Qantas line in order to obtain high off-season prices.

Ex-Servicemen in Australia have made more than 250 applications for air service licenses, having in mind use of surplus aircraft. Proposed new airworthiness regulations, which would ground several present commercial types, would require extensive modification of such aircraft and probably bring severe reductions in payload.

COLOMBIA—Airline service was recently established between Bogota and Caracas, based on an exchange flight agreement between two governments. Operation will be by TACA de Colombia and TACA de Venezuela. Former also inaugurated service to Quito, Ecuador.

PERU—Limatabo airport, now considerably enlarged, has two new 6,000-ft. runways. New terminal buildings and hangars are also under construction. During first six months of '45, Peruvian airlines carried 31,373 passengers, 730 tons of cargo, 70 tons of parcel post, and 22 tons of mail.

ARGENTINA—Notwithstanding fact that Government recently established a chosen instrument airline, Dodero is proceeding with plans to operate extensive services in Latin America. Equipment includes five converted Short Sunderlands (one of which recently made a survey flight to U. S.), and five DC-4s.

CUBA—Major upset in Cuba's aviation history was award to Expreso Aero Inter-Americano of mail contract to U. S., via bid of 8.3¢ per lb. against $4.00 by PAA.

MEXICO—Servicio Aereo Panini announced that 49% of its stock had been acquired by Aero Industries Corp. of New Haven, Conn. Panini operates 4,700 route miles in Mexico, entirely on experimental permits. Reported use of DC-4s is discounted, since most government controlled schedules of Panini involve short distances with small airports, while average traffic loads are relatively low.

TURKEY—Signing of U. S.-Turkish air pact, providing for fifth-freedom traffic, is reported to be first case in which Turkey has allowed a foreign airline to pass over its territory in peacetime.

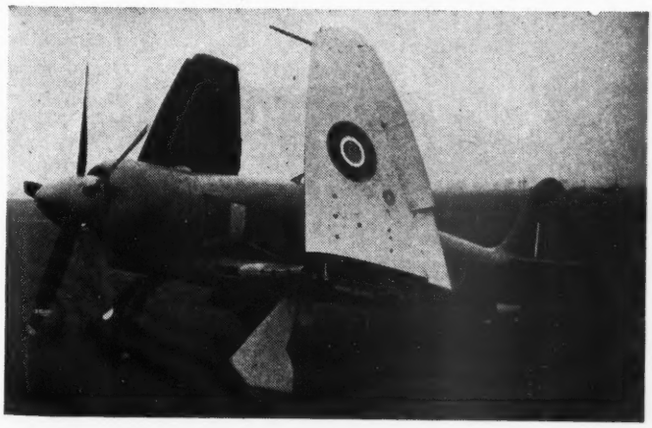
WORLDATA . . . . . By "VISTA"

Signing of the Anglo-American air agreement was attacked during discussions in Parliament, especially when the Air Minister said his country had to make more concessions than the U. S. When the issue comes up for full debate, general fireworks are expected, amplified by opponents of purchase of Lockheed Constellations for British airlines, which supposedly are required to stick to a "fly British" edict. Besides these Constellations, Britain's airlines are also operating 25 German Junkers 52s, factories being unable to supply suitable similar aircraft in time for immediate service.

BOAC's plans for the immediate future include restoration of prewar "Empire" routes, also operation of faster planes at higher frequencies. Long-term plans call for both local and express services on all routes, with local service fares at low levels to promote mass travel. BOAC also announced it will follow American practice and charge extra fares for express services. In all, there will be six trunklines—England-Australia-New Zealand, known as the Kangaroo route; England-South Africa, the Springbok route, and England-India, the Tiger route. Plans also call for a Dragon route to Tokyo, a double trans-Atlantic route to Canada and U. S., and a West African run to Accra and Lagos. Frequencies vary from weekly for the Tokyo route to daily for the U. S. service and 10 flights per week to India. Fares quoted are relatively high, amounting to an average of 7½¢ U. S. per mile. While no definite statement has been made on equipment, majority of BOAC's services are now operated with York's, Lancastrians, and Empire flying boats. It is expected these will be replaced by Tudors and the Handley Page Hermes, with the six-engine Brabazon I coming into service in a year or so.

With the fate of many U. S. international services hanging fire because of pilot's wage differences, it is interesting to note that BOAC's Senior Captains will get $4,400 a year, considered a "plum" in England. Senior Captains, 2nd. class, will get from $3,000 to $4,000, Jr. Captains $2,800, First Officers $2,200, and Second Officers $1,700.

CAB approval of Swedish Intercontinental Airlines' application for service into the U. S. aroused great enthusiasm in Stockholm. Test flights have been made with converted Boeing B-17s, which will shortly be replaced by new Douglas DC-4s. SILA has also ordered four Boeing Stratocruisers, which will make 14-hr. non-stop flights between Stockholm and N. Y. C. It is expected SILA's approval will accelerate plans of other Scandinavian carriers to take an active part in trans-Atlantic service.

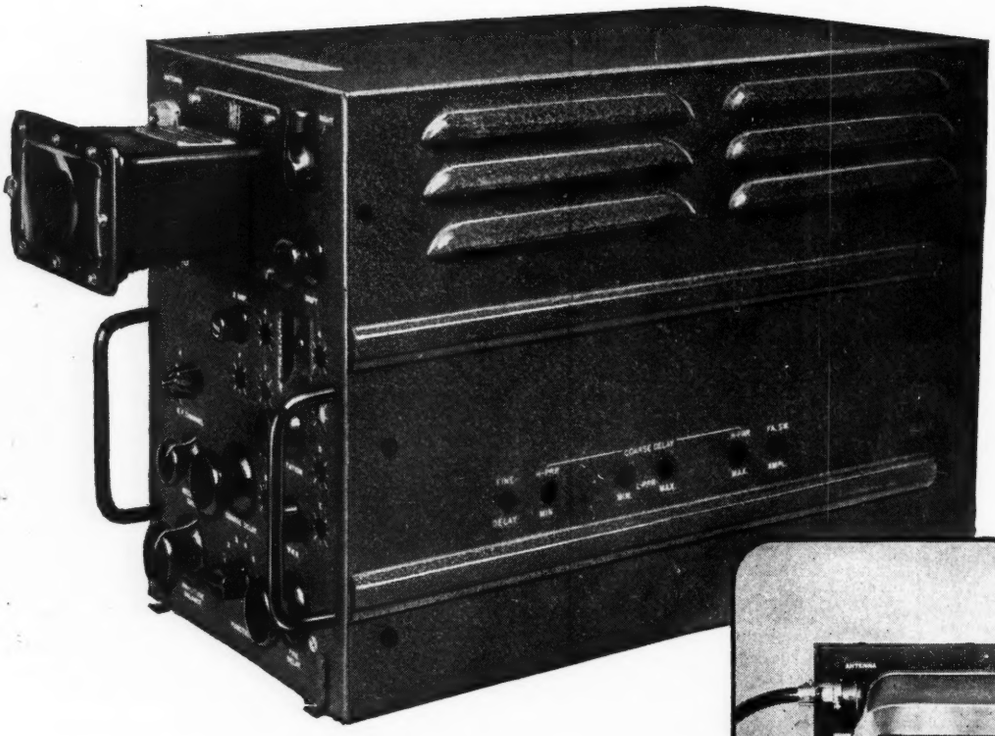


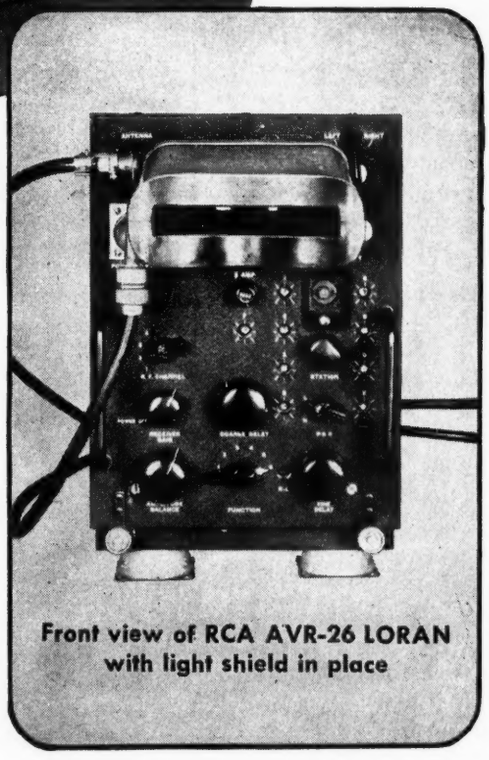
AFTER THE TEMPEST THE FURY

Developed from Tempest, Royal Navy's Hawker Sea Fury 10 carrier fighter is powered by 2,400-hp. Bristol Centaurus turning a five-blade Rotol propeller. With span of 35 ft. 8 in., length 34 ft. 7 in. wing area 280 sq. ft., and weight of 12,030 lb., craft is stated to have a 440 mph. top speed at 24,000 ft. Armament consists of rockets and four 20-mm. cannon. Innovation on British carrier craft are these power-operated folding wings

LORAN BY RCA

Available Now for Commercial Aircraft





Front view of RCA AVR-26 LORAN with light shield in place

RCA, basic designer of all air-borne LORAN equipment used in this country and largest producer of LORAN for military installation now makes this modern aid to navigation available for commercial aircraft.

Well proven under the severest conditions of wartime usage the RCA AVR-26 LORAN embodies even further refinements for peacetime application. Weighing only 35 pounds this compact unit provides the ultimate in accurate long-range navigation—precision fixes when clouds make celestial shots impossible and severe static prevents the taking of aural bearings.

LORAN is fast, too—bearings can be taken in less than a minute. Power consumption is low, and mounting space is comparatively small —the AVR-26 measures only 12¼" high, 9⅛" wide, and 23" deep.

If you have a problem in long range navigation it's very likely you'll find the answer in LORAN. For further details write today to Aviation Section, Dept. 15-D Radio Corporation of America, Camden, New Jersey.

AVIATION SECTION

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

Eastern Air Lines plans to split its common stock whereby stockholders will be issued four shares for each share of common stock currently held. Under proposed plan outstanding common shares would be increased from 600,000 to 2,400,000 shares. Shareholders also will be asked at annual meeting Apr. 23 to increase authorized common stock from 1,000,000 to 5,000,000 shares.

Globe Aircraft is offering its stockholders one share of new preferred stock at $9 a share on basis of one preferred share for each share of common held. That portion of new stock not subscribed for by common holders will be offered to public at $10 a share. Proceeds, amounting to $1,275,000, will be used to pay up a $960,000 RFC loan and to purchase a plant at an estimated cost of $250,000, and balance will be used for working capital.

Air Associates is negotiating purchase of a Defense Plant Corp. factory at Teterboro, N. J. Company reports a loss of $51,740 for quarter ended Dec. 31, 1945.

Latin American Airways has made a public offering of 99,166 common shares at $3 a share. Proceeds will be used to acquire equipment and personnel. Company was organized to operate in Ecuador.

Bendix Helicopter stock held by estate of late Vincent Bendix (amounting to 507,400 shares) is being sold in over-the-counter market. Kobbe, Gearhart & Co. is principal underwriter.

B. F. Goodrich has purchased airplane wheel and brake division of Hayes Industries. This move is part of company's postwar program to extend its operations to all branches of aviation.

Lockheed Aircraft has purchased all capital stock of Pacific Engineering Corp. of Los Angeles. It is planned to merge company with Airquipment Co., recently organized by Lockheed to manufacture ground handling equipment.

Piper Aircraft has registered 150,000 shares of common stock with SEC. Net proceeds from public sale of this stock will be used to increase working capital. Net profits for fiscal year ended Sept. 30 were $143,152 or 21c. a share, against net profits of $277,000 or 44c. a share in preceding fiscal year. Company operated at a loss for first four months of current fiscal year, however losses have been reduced as unit production and sales have expanded.

Thompson Products will spend $5,000,000 this year to complete purchase of Thompson Aircraft Products plant, and $3,000,000 will be expended for additional tooling. Net income for 1945 was $1,520,954 or $3.55 a share, against '44 net income of $2,906,312 or $7.45 a share. Sales were $94,811,337, against $130,847,120 in 1944.

Pacific Airmotive is offering 150,000 shares of its capital stock to stockholders on basis of 3/10th share for each share held. Union Oil Co. of Calif. has agreed to buy all shares not subscribed by stockholders.

American Airlines has arranged for interim financing through bank loans totaling $25,000,000. Proceeds will be used to buy aircraft.

Brewster stockholders will meet Apr. 5 to vote on dissolution of company. Net book value of common stock was $4.91, based on balance sheet as of Oct. 31, 1945.

Breeze Corp. reports 1945 net income of $743,540, or $2.86 a share, against 1944 net income of $1,012,691 or $3.89 a share. Pres. John T. Mascuch told stockholders that company planned to enter non-aviation manufacturing fields in addition to continuing its production of aircraft products.

Spartan Aircraft has been sold by Skelly Oil Co. to J. Paul Getty of Los Angeles for $1,441,546.

Ex-Cell-O Corp. reports net income of $1,947,653 or $4.88 a share for the fiscal year ended Nov. 30, 1945, against net income of $2,136,020 or $5.36 in preceding fiscal year. Sales were $54,835,818, against $54,973,661 in preceding year.

Irving Air Chute has declared a 25c. dividend payable Apr. 1. Company took no action on dividends in last half of '45.

Pan America has transferred control of Compania Mexicana de Aviacion to citizens of Mexico through sale of an additional 13,750 shares of stock. In 1944 PAA sold 44% of Mexican airline's stock to nationals of that country.

Menasco Mfg. Co. reports net income of $349,864 or 37c. a share for twelve months ended June 30, 1945, against net income of $236,194 or 25c. a share in preceding twelve months. Sales were $15,782,696 against $16,619,329. Pres. John C. Lee said firm's postwar plans call for production of power plant and hydraulic equipment for commercial transportation. Landing gear, hydraulic jacks, and electric washing machines currently are being manufactured.

ADDING IT UP.....By RAYMOND HOADLEY

Airline Merger? From the financial district come reports of what the "Wall Street Journal" terms as "hush-hush" negotiations between Transcontinental & Western Air and Northwest Airlines for a new globe-girdling airline. Since TWA's petition for a route to the Orient got an adverse report from a CAB examiner there is said to be talk of an arrangement to pool the two companies' overseas operations, The examiner recommended that the route to the Orient go to Northwest.

New Air Commuting Company. Nineteen prominent bankers and industrialists from New York and Pittsburgh are understood to have chipped in $10,000 apiece to finance Air Commuters, Inc., a new outfit formed to serve commuters in the New York metropolitan area by rendering an airport-to-New York and an airport-to-airport passenger service. The company plans to start operations late this year.

Commercial Plane Orders. Aircraft manufacturers are now estimated to have more than $330,000,000 in orders from domestic and foreign airlines for transport planes. It's believed that less than 50% of this backlog will be delivered this year. Reconverts are included in total.

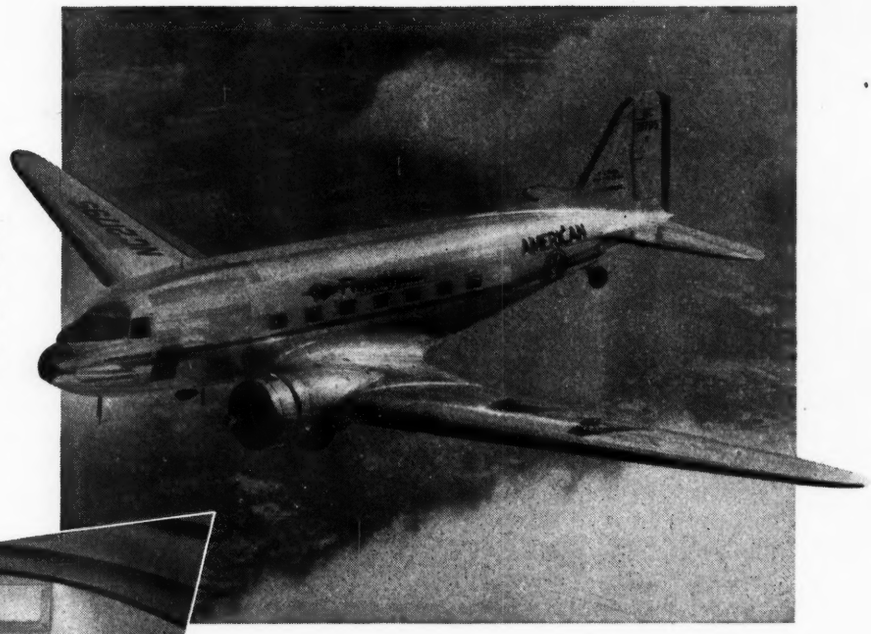
Conversion Orders. But in addition to their transport orders, the plane makers have a $70,000,000 backlog of orders for converting military planes. This business will be completed this year and should prove of considerable aid, earnings-wise, to such companies as Douglas, Martin, and Republic.

Contract Settlements. War contract settlements are ahead of schedule. However, many of the aeronautical contracts are in the cost-plus category, and settlement of this type of contract has been admittedly slow. When he files his claim, the contractor gets 80% of what is estimated to be due him, hence there has been little or no actual distress in the aircraft industry because of delayed settlements.

Martin Enters New Field. Without any trimming of sails in the aircraft field, Glenn L. Martin proposes to become an important factor in the plastics industry. Having perfected Marvinol, an elastic plastic material, to its satisfaction, the company is proceeding to erect a $1,500,000 plant with an annual capacity of 11,000,000 lb. of the new product.

Airline Expansion. Once more CAB has blocked expansion plans of a domestic arline—this time by ordering National Airlines to divest itself of all control of Caribbean-Atlantic Airlines, a Puerto Rican carrier. This order means that stockholders of the latter must be given back the holdings they deposited with National as part of the purchase agreement. This upset of a merger deal shows it's best to get CAB approval before attempting to carry out the mechanics of a merger.

Personal Plane Sales. Reports from the private plane makers tell of rapidly expanding order backlogs and increased production schedules. Piper has $17,000,000 in orders and has scheduled output at 50 planes a day this spring...Republic has orders for 5,000 Seabee amphibs and is projecting full-scale production this summer...Globe Aircraft has firm purchase orders amounting to $18,000,000...Aeronca plans an output of 50 craft daily this summer...Beech is turning planes out at the rate of $3,000,000 worth a month, and Bellanca has orders for 1,300 planes...Taylorcraft, with orders for 7,000 planes, is producing at the rate of 15 planes a day...Luscombe is building 6 a day.



This American Airlines DC-3 Flagship saw service with the AAF during the war and has now been converted for commercial use. The picture below shows the redecorated cabin with the Barber-Colman Cabin Thermostat on the forward bulkhead.

BARBER-COLMAN CONTROLS KEEP UNIFORM TEMPERATURES IN THE CABINS OF THE DC-3s FLOWN BY AMERICAN AIRLINES

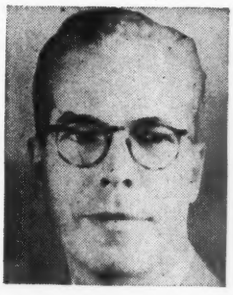
Cabin temperature control units developed by Barber-Colman especially for DC-3 conversions have been successfully installed on many of the airliners now flying again in commercial service. Only two pieces of equipment are needed — a Cabin Thermostat and a Control Motor for the heat-transfer by-pass dampers — and *their total weight is only 3 lbs. 11 oz.* By a practical application of automatic rebalancing of a bridge circuit, this system is able to achieve fully proportioning control which acts quickly and accurately without hunting. Tests show immediate response to rapid changes of outside temperature, resulting in uniform maintenance of desired cabin temperature. All Barber-Colman aircraft equipment is carefully designed and built for reliable operation. For details, write for our bulletin on Aircraft Controls.

LOOK FOR BARBER-COLMAN CONTROLS ON THE LEADING LUXURY AIRLINERS

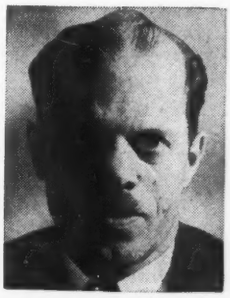
BARBER-COLMAN COMPANY

1221 ROCK STREET, ROCKFORD, ILLINOIS

EDWIN L. ZIVI has been made chief engineer for Edo. Previously with Martin, he worked on B-10B and Clipper. As project engineer on Martin 146, he was co-inventor of Mareng leakproof fuel cell. Earlier he was with Keystone and worked on LB-5 and Loening amphibian, and later joined Budd Aircraft.



H. J. E. REID, of NACA, has received an honorary degree as doctor of engineering from Worcester Polytechnic Institute in recognition of his pioneer work in design and operation of wind tunnels and flight research instruments. He is now engineer in charge of Langley Memorial Aero Lab.



E. A. PETERMAN returned to Lockheed to head company's CAA liaison office as staff engineer in charge of work on commercial planes. He comes from Wright Field, where he served for 4 yr. as chief, cargo branch, aircraft projects, engineering div. He left company in '40 to head National Guard Unit.

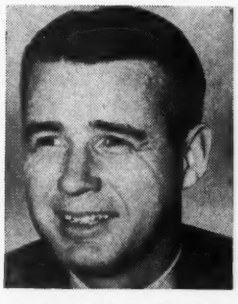
BRIG. GEN. ERIK H. NELSON has been named technical adviser to Swedish Intercontinental Airlines (SILA). An internationally known aviator and aero expert, he is recognized as one of AAF's leading authorities on Boeing B-29 maintenance. His hq. will be in N.Y.C. At present he is visiting aircraft makers.

GILBERT B. SMITH has been appointed mgr. of industrial aid div. of Trans-Marine Airlines, which is being formed to provide transportation for executives on a contract basis. Until recently he was CAA liaison officer in Caribbean area. He is a graduate of Northwestern with a B.S. in economics.

COL. R. E. ELWELL, formerly of AAF, resumed his position as CAA General Counsel. During war he served abroad in developing military air traffic control system in Europe and Middle East. He also engaged in a study of AAF operational training accidents.

H. MAT ADAMS has been appointed asst. to pres., of Air Cargo Transport Corp. Formerly chief of operations for SHAEF's psychological div., he was educated at University of Ill. and admitted to bar in that state, where he practiced law. (Tommy Weber photo)

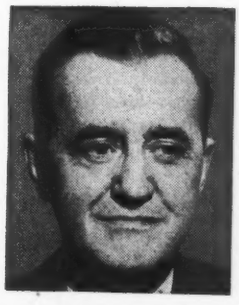
CARL HAVENS has been appointed asst. to W. A. Plees, Convair v.-p. in charge of sales, and will supervise advertising, sales promotion, and public relations. He formerly held similar position with GM Oldsmobile div. His new hq. will be in San Diego.



GEORGE W. LUSK has been named district traffic mgr. for Braniff in Memphis, Tenn. He entered aviation in '29 when he joined TWA. During war he was a Maj. in priority and traffic section of AAF, and was only discharged recently.

JOHN H. SEATON has been named mgr. of Goodrich's aero mfg. div., formerly known as de-icer and fuel cell div. A graduate of Ohio Northern U., he joined company in '27 and has been industrial products div. chief design engineer since '42. He's an SAE member.

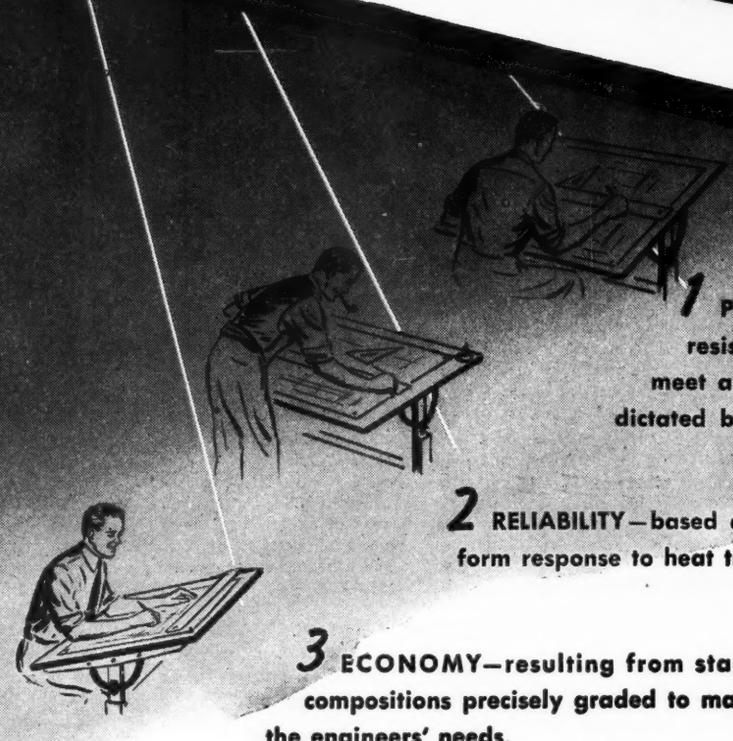
D. L. McDANIEL (left) has been appointed asst. to vice-pres., operations, of UAL, and will be in charge of correlating airline's educational service dept. with all upgrading training programs for operational personnel. During war he was mgr. of company's Oakland training center. ROBERT M. RUDDICK has been designated airline's European mgr., with offices in London. With UAL since early '43, he will maintain airline's contacts with North Atlantic airline and steamship companies. He was formerly in newspaper advertising and circulation work.



P. P. WILLIS (left) has been elected vice-pres., advertising, for AA. He has handled airline's advertising since company was organized in '20. A graduate of DePauw University, he went into newspaper work, then became press agent for Indianapolis Speedway. Later he joined Willys-Overland, and in '26 he founded his own agency. R. E. S. DEICHLER (center) has been named vice-pres., administration, of airline. Recently discharged from AAF, he has been exec. asst. to chairman of board. Educated at Pennsylvania University, he joined airline in '45. REX W. SMITH, JR., was named vice-pres., public relations. He was made airline's director of public relations in '45 after an extensive newspaper and public relations career. He served with AAF for 3½ yr., leaving with rank of Col. (Bachrach photo)

Triple reasons for specifying...

TRIPLE ALLOY STEELS *containing* NICKEL



1 **PERFORMANCE**—Strength and toughness, resistance to wear, fatigue or shock to meet a wide range of requirements, as dictated by design.

2 **RELIABILITY**—based on consistently uniform response to heat treatment.

3 **ECONOMY**—resulting from standard compositions precisely graded to match the engineers' needs.

Experience shows that triple-alloy steels containing Nickel are solving some mighty big problems in many industrial fields. They have established outstanding service records in some of the most exacting applications. The many standard compositions available make it possible to select *accurately*, and with economy, triple-alloy steels to fulfill the requirements of a great variety of applications.

We invite inquiries regarding the selection and uses of triple-alloy steels, containing Nickel.

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NEW PRODUCTS

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Products and Practices

INFORMATION TIPS

This selected information on new publications and products is offered by the "AVIATION" Reader's Service through cooperation with the manufacturers. It helps executives save valuable time, provides profits through convenience. To obtain literature or additional data on new products described, simply fill in form below, clip it to your letterhead, and mail. There is no cost, no obligation.

ENGINEERING DATA

Cylinders 1

Bulletin 453 from **Engineering Products Co.**, Los Angeles, describes heavy duty cylinders designed for operation by air, oil, or water, giving various types, sizes, and models available.—**AVIATION, Apr., '46.**

Layout Protractor.....2

Developed to make accurate layouts for use on optical projectors and form grinders, new glass layout protractor is described in leaflet issued by **Engineering Specialties Div., Universal Engraving & Colorplate Co.**, Buffalo.—**AVIATION, Apr., '46.**

Laboratory Service.....3

Described in booklet, "Your New Laboratory, Sir", issued by **Behr-Manning Corp.**, Troy, N. Y., are methods and demonstration rooms located in branch offices for customer use in pre-testing grinding, sanding, and finishing tool-ups.—**AVIATION, Apr., '46.**

Aluminum Research 4

Brochure, "The Kingston Research Laboratory", published by **Aluminum Laboratories**, Kingston, Ont., describes research work being done by company in light metals field.—**AVIATION, Apr., '46.**

Brakes 5

Bendix Products Div., Bendix Aviation Corp., South Bend, Ind., has issued folder describing segmented rotor brake which is stated to give aircraft more braking capacity with economy of weight and space.—**AVIATION, Apr., '46.**

Set Screws.....6

Ground thread set screws and size-marked gear grip socket head cap screws are described in folder from **Parker-Kalon Corp.**, New York City.—**AVIATION, Apr., '46.**

Cutting Fluids.....7

Containing instructions for use of fluids, new booklet, "Water-Mixed Cutting Fluids", issued by **D. A. Stuart Oil Co.**, Chicago, also has suggestions for mixing fluids, data for designing cutting fluid systems, and technical data.—**AVIATION, Apr., '46.**

Peelable Film.....8

Brochure from **Better Finishes & Coatings, Inc.**, Newark, N. J., describes applications of a peelable plastic film, "Liquid Envelope", designed to give metal parts a protective coating by hot and cold spray, hot and cold dip, and brush application.—**AVIATION, Apr., '46.**

Metal Fasteners.....9

Catalog No. 845 from **Simmons Fastener Corp.**, Albany, N. Y., describes quick lock, spring lock, and dual purpose safety nut fasteners, also gives design, construction, and engineering data, as well as installation instructions.—**AVIATION, Apr., '46.**

MACHINERY & ACCESSORIES

Melting Furnaces.....10

Describing induction metal melting furnaces, controls, and auxiliaries, Bulletin 11-B published by **Ajax Electrothermic Corp.**, Trenton, N. J., also gives principles of operation, and melting performances.—**AVIATION, Apr., '46.**

Machining Help 11

Containing suggestions for machining mating parts, angular drilling and reaming, and fixtures for broaching, "Tool Tips", Vol. 20, No. 6, published by **Ex-Cell-O Corp.**, Detroit, also includes inset "Business Booms and Depressions", an economic history of country.—**AVIATION, Apr., '46.**

Drills 12

Booklet now available from **Republic Drill & Tool Co.**, Chicago, gives design and performance details on new type drill which is stated to give increased speed in mass production drilling.—**AVIATION, Apr., '46.**

Die Sets.....13

Literature from **Lempco Products**, Bedford, Ohio, describes anti-friction die sets featuring guide pin stated to resist freezing when operated at high speeds.—**AVIATION, Apr., '46.**

Control Instruments 14

Catalog No. W1800 containing information on line of automatic controlling, recording, and indicating instruments, has been issued by **Bristol Co.**, Waterbury, Conn. It gives specification data on each instrument and drawings showing basic methods of application.—**AVIATION, Apr., '46.**

Interval Timer.....15

Designed to control running time of equipment, new electric interval timer is described in literature from **R. W. Cramer Co.**, Centerbrook, Conn.—**AVIATION, Apr., '46.**

Material Handling.....16

Booklet containing illustrations of installations and applications of factory tractors, trailers, and lift trucks has been issued by **Mercury Manufacturing Co.**, Chicago.—**AVIATION, Apr., '46.**

Stock Tubes.....17

Designed for use on both single and multiple spindle automatic screw machines, new stock tube, described as eliminating noise of revolving bar stock, is described in folder from **Coriett-Turner Co.**, Chicago. It is made in sizes from ½ to 2⅝ in.—**AVIATION, Apr., '46.**

High Speed Lathe.....18

Incorporating the "Precise-35", an electric grinder and handtool, which has range of working speeds from 0 to 40,000 rpm., new small lathe is described in folder issued by **Precise Products Co.**, Racine, Wis. Also given are specification data on types of tools and accessories.—**AVIATION, Apr., '46.**

Die Casting Machines.....19

Literature from **Lester-Phoenix**, Cleveland, describes two new die casting machines for production of heavy castings. These are Model HP-3½-SF for zinc, tin,

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and lead alloys, and Model HP-8½-X-SF for aluminum, brass, and magnesium.—AVIATION, Apr., '46.

Tractor Cranes and Lift Trucks.....20

Bulletins from Hyster Co., Peoria, Ill., describe winches, dragline, clamshell, and crane equipment as applied to track-laying tractors, also shows Model 40 pneumatic tired lift truck.—AVIATION, Apr., '46.

Involute Spline and Shaving Process..21

Folder from National Broach & Machine Co., Detroit, gives information on manufacture of involute splines, tolerances, and spline tables. Another company folder describes machinery, tools, and processes for shaving operations.—AVIATION, Apr., '46.

Die Casting Machine.....22

Designed to eliminate cold metal from shot furnace, new die casting machine, Model 400, available for zinc, tin, and lead casting, or for magnesium, aluminum, bronze or brass, is described in bulletin from Cleveland Automatic Machine Co., Cleveland.—AVIATION, Apr., '46.

Plastic Dip Tank.....23

Leaflet 557 issued by Aeroil Products Co., West New York, N. J., gives specifications, illustrations, and details on new Model 6 1-gal. portable plastic dip tank.—AVIATION, Apr., '46.

Torque Wrenches.....24

JO Manufacturing Co., South Gate, Calif., has issued new catalog showing line of torque wrenches. Given are specifications and tables of suggested torque values.—AVIATION, Apr., '46.

Counting Machine 25

Operation principle, adaptations, and specifications of "Shadowcount", new counting machine, are given in catalog page issued by Autotron Co., Danville, Ill. Unit operates with an optical system incorporating use of photoelectronic circuit.—AVIATION, Apr., '46.

Allegheny Stainless In Ryerson Stock

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RYERSON STEEL

Welding 26

Catalog 1B from Stackpole Carbon Co., St. Marys, Pa., contains details and data on welding electrodes, plates, rods, paste, and resistance welding tips.—AVIATION, Apr., '46.

ELECTRICAL

Motors and Generators.....27

Catalog FB showing fractional horsepower motors and generators, from Electric Indicator Co., Stamford, Conn., gives technical data and performance curves on a.c. and d.c. units.—AVIATION, Apr., '46.

Power Factor Regulator.....28

Stated by maker to raise power factor by taking magnetizing current off line, special power factor regulator is described in bulletin from Modern Control Equipment Co., Chicago.—AVIATION, Apr., '46.

Plugs and Receptacles.....29

Bulletin from Cannon Electric Development Co., Los Angeles, describes Type AP plugs and receptacles designed for weather resistant radio and telephone circuits, and included are specifications and construction details.—AVIATION, Apr., '46.

Radar 30

Booklet, "Radar and Your Telephone", issued by Bell Telephone Laboratories, N.Y.C., describes principles of radar and its applications in war on land, sea, and in air, together with proposed uses for peacetime transportation of all types.—AVIATION, Apr., '46.

STEELS

Stainless Steel Fabrication.....31

Folder from Alloy Mfg. Co., Pittsburgh, illustrates use of stainless steel for fabricated parts and presents table of type numbers and also analysis.—AVIATION, Apr., '46.

PLASTICS & SYNTHETICS

Conveyor Belt.....32

Designed to handle heavy rough material, Neoprene conveyor belt is described in "Neoprene Notebook", issue No. 35, published by Rubber Chemical Div. of E. I. duPont de Nemours & Co., Wilmington, Del.—AVIATION, Apr., '46.

Synthetic Rubber.....33

Bulletin No. 6885 from Raybestos-Manhattan, Passaic, N. J., describes "Flexlastics", a compound of natural and synthetic rubber. Applications are depicted, also testing equipment, and principal products are considered.—AVIATION, Apr., '46.

Plastic Compounds.....34

"Vinylite Plastics — Elastomeric Compounds" is new booklet issued by Bakelite Corp., N.Y.C., showing applications of material and discussing molding and extrusion compounds, flexible sheeting and film, cloth coating compounds, and various properties.—AVIATION, Apr., '46.

PLANT SERVICE

Feed Water Control.....35

Description and specifications of different types of feed water controls are given in Bulletin 103-C from Combustion Control Corp., Cambridge, Mass.—AVIATION, Apr., '46.

Plant Construction.....36

Second edition of "Plan and Projects," published by F. H. McGraw & Co., N.Y.C., is devoted to personnel and operation of firm's Pittsburgh office. Special feature article concerns building of Reynolds Alloy Co.'s aluminum plant at Sheffield, Ala.—AVIATION, Apr., '46.

Floor Paint.....37

An article describing use of "Paratex" rubber base floor paint in airplane engine test cells appears in Vol. 3, No. 6 of "Building Maintenance," published by Truscon Laboratories, Detroit.—AVIATION, Apr., '46.

Maintenance Paint.....38

Stated to be resistant to hot acids, al-

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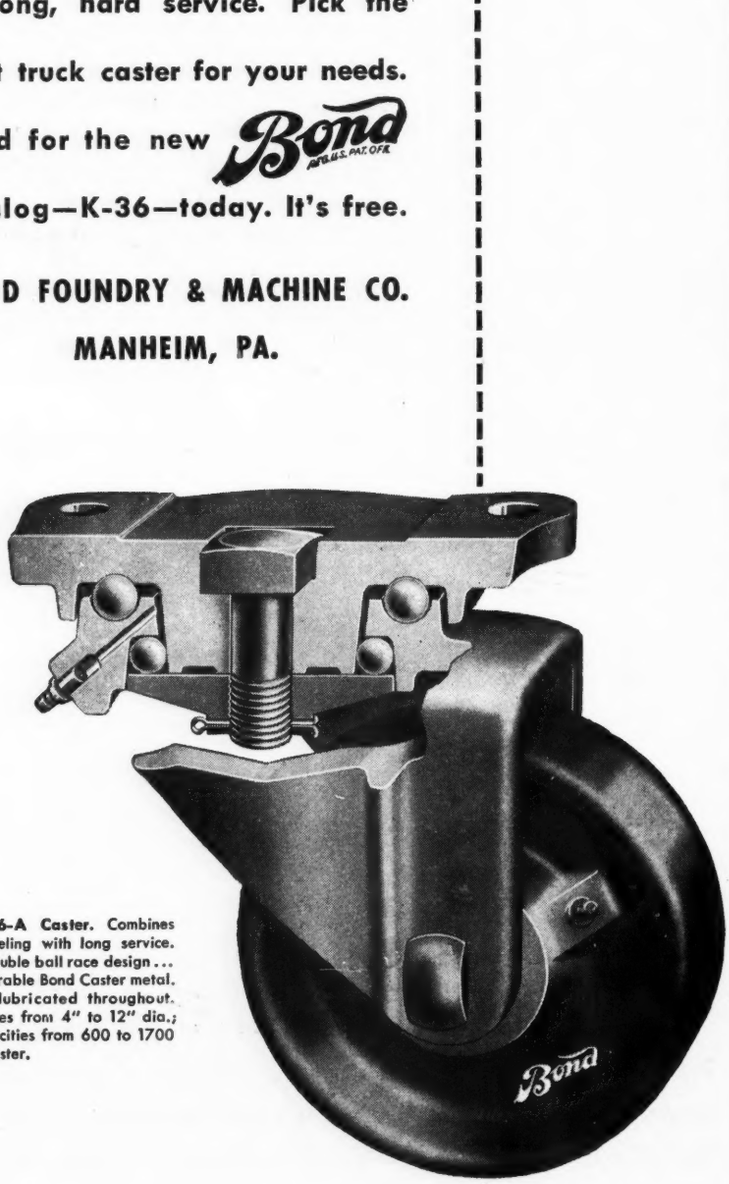

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kalis, and water, and to be quick drying and odorless, "Pen-Kote 500," a maintenance paint, is described in folder issued by **Peninsular Chemical Products Co.**, Van Dyke, Mich.—**AVIATION, Apr., '46.**

Floor Maintenance Equipment.....39

Bulletin from **G. H. Tennant Co.**, Minneapolis, describes electric self-propelled Model J floor machine with 12 in. drum type accessories. It is stated to remove incrusted grime and to dry clean, sweep, polish, burnish, and sand.—**AVIATION, Apr., '46.**

AIRCRAFT & ACCESSORIES

Portable Radio Receiver.....40

Lear Aircraft Radio Sales Div., Grand Rapids, Mich., announces resumption of production on "Learavian," portable three-band radio receiver for use on private planes.—**AVIATION, Apr., '46.**

Radio Accessories.....41

Literature from **Sperry Gyroscope Co.**, Great Neck, N. Y., describes microwave measuring equipment, klystrons and accessories, and microwave instruments. Including engineering data and specifications, it also gives klystron spectrum chart and characteristic table.—**AVIATION, Apr., '46.**

Jet Propulsion.....42

Comparing gasoline engines with jet engines, new booklet published by **Thompson Products**, Cleveland, describes how jet engine works, how it is used in aircraft, and problems overcome in developing and perfecting it.—**AVIATION, Apr., '46.**

Propellers 43

"Wherever Man Flies" is illustrated and descriptive story of development of hollow steel adjustable pitch propeller, published by **Hamilton Standard Propellers, Div., United Aircraft Corp.**, East Hartford, Conn., showing its use by peacetime pioneers of aviation up to its present-day employment in military aircraft.—**AVIATION, Apr., '46.**

NEW·PRODUCTS

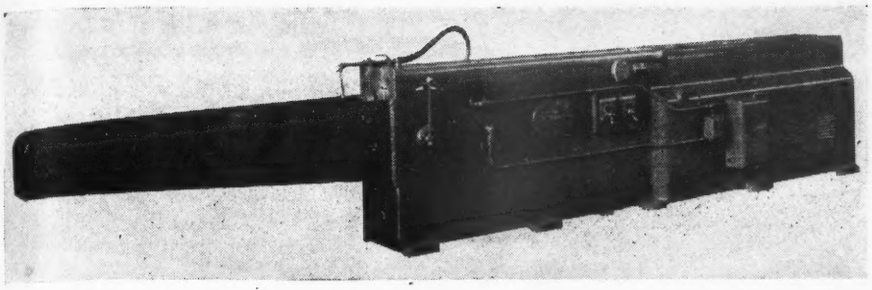
Machinery & Accessories

Template Grinder.....44

Sheffield Corp., Dayton, has developed template grinder with electronic control of wheel head axial traverse for grinding templates and other work up to 72 in. long, 8 in. deep, and 1 in. thick, without repositioning. Templates for many types of profiles, including those in aircraft wing and fuselage manufacture, can be made. Grinder consists of base on which wheelhead with control panel and optical equipment traverses, with electronic control unit and work table with adjustable paralleled work supports. When work is clamped to table, supporting parallels are adjusted to rough outline of work, and wheelhead is positioned on transverse ways by electronic controls so as to bring wheel to point where grinding is to start. Wheelhead may be adjusted on turret to a maximum of 40 deg. each side of center. Wheel reciprocating slide is positioned for required stroke within range of 0 to 1¼ in. Speed of reciprocation may be 50 or 100 strokes per minute. Operator views work through 20-power microscope in performing operation. Four reticles of .005, .0075, .010, and .015 in. dia. are provided with microscope.—**AVIATION, Apr., '46.**

Horizontal Broaching Machine.....45

Described as suitable for heavy duty internal broaching, two new types of hori-



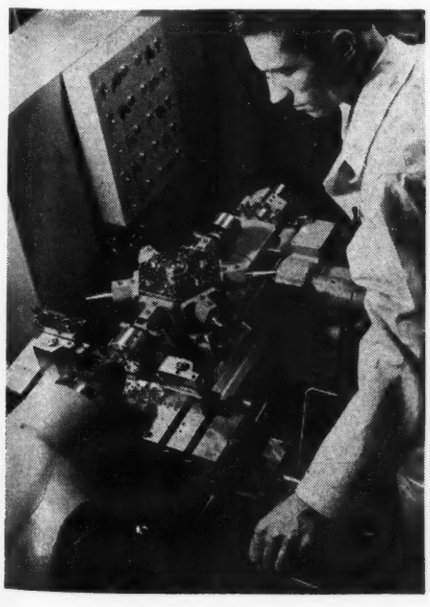
zontal broaching machines, announced by **American Broach & Machine Co.**, Ann Arbor, Mich., feature new design in machine bed which has rolled wall construction which forms double walls and lends strength and rigidity to base. Model HD-15-66 has 15-ton pull capacity, 66 in. stroke, and maximum broaching tool length of 72 in. Model HD-20-66, of 20-ton pull capacity, has same stroke and tool length.—**AVIATION, Apr., '46.**

High Frequency Heating Unit.....46

W. T. La Rose & Associates, Troy, N. Y., announces "Champ", new high frequency heating unit which is stated to heat 6 lb. of material to molding temperature in 1 min. Preforms or powder are visible at all times. Mounted on rubber casters, unit weighs 500 lb., is 20 in. wide, 30 in. deep, and 49 in. high. There is one control operation, with dual safety interlock switches, electrical and mechanical, and automatic electric time control with intervals from 0 to 3 min. by seconds. Compounds requiring different time cycles may be heated at same time. Operation is on 220w. 440v., three-phase.—**AVIATION, Apr., '46.**

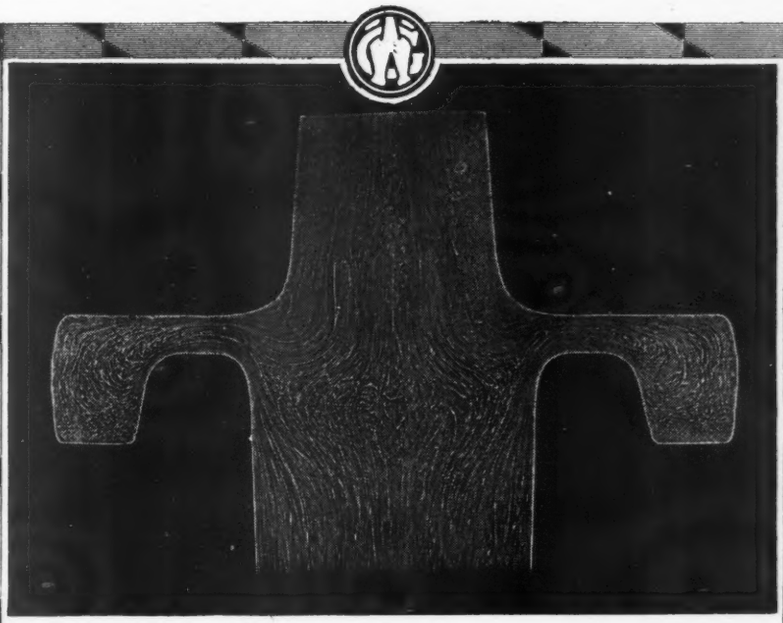
Small-Work Manufacturing Lathe....47

Designed to handle small turning work in quantities of 25 to 500 or more pieces with ease and quickness of set-up, new hand screw 10-in. "Speed-Matic" manufacturing lathe is announced by **Monarch Machine Tool Co.**, Sidney, Ohio. Spindle has 3 in. American cam lock spindle mounting. It is mounted on ball bearings and is bored to accommodate stock up to ⅞ in. Gear box has been changed in design, permitting either high or low feed of feed rod to be obtained by shifting one lever. Power feed turret has six additional feeds. Feeds range from .0005 in. to .016 in. per rev. Turret is manually operated by capstan handwheel and is power fed with rod which connects to main gear box, is six-way, and will take tools for any turret lathe operation. It is reported to index to six stations within .0002 in. out 2 in. from face of turret. Hand-operated air-feed pusher type collet attachment is used for time saving, and constant air pressure on bar stock feeds it through collet to stop on one face of turret by opening and closing collet. This holds stock in position for machining. Machine features new self-centering ball bearing cut-off slide with front and rear blocks for holding tools. Tools are hand-feed to do forming, necking, or cutting off. Upon completion of operations, self-centering slide is returned to original position by means of spring and helical rack mechanism. Spindle speeds for each face of turret, as well as cut-off slide, are pre-selected to porper positions by means of potentiometers. Ten station panel has six stations for turret, two for front and rear tools, and two additional speeds for other operations. Reset button returns panel to original starting condition which remains unchanged until turret is indexed for first spindle speed for initial operation.—**AVIATION, Apr., '46.**



Automatic Cut-Off Saw.....48

Designed to convert manually operated metal cut-off saws to automatic operation, new attachment, "Saw-Matic", made by **Machine Specialties,** Chicago, consists of vise clamp mechanism, pull-up device, saw lifting and lowering device, and length control valve. Maker states unit will automatically cut any length from 3/16 in. up, and will operate all day without attendant, cutting lengths with .010-in. tolerance by means of friction pull-up device and sensitive valve. By turning air valve change is made from automatic to manual operation. Required air pressure is 60 lb.—**AVIATION, Apr., '46.**



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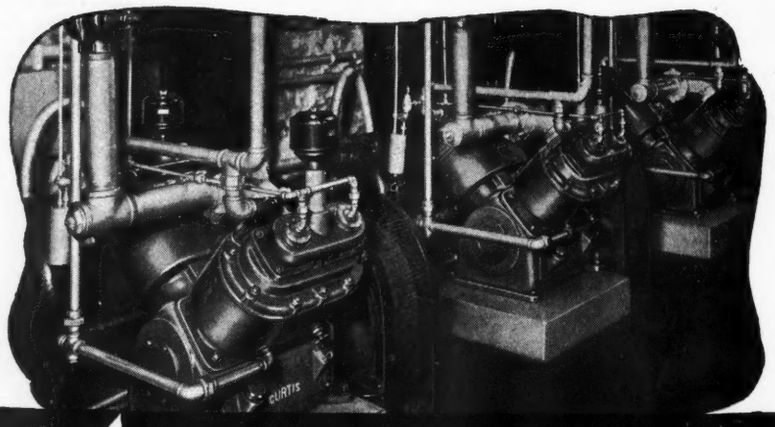

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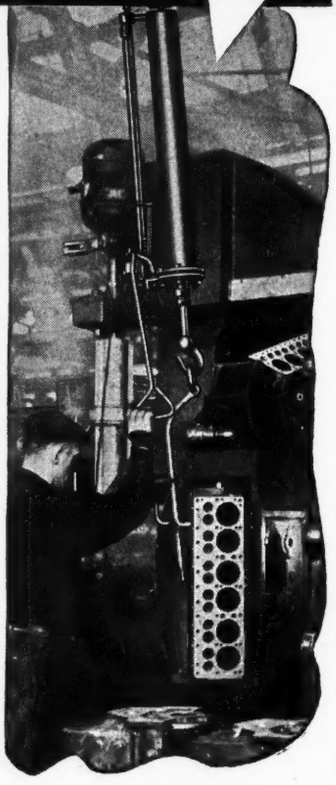

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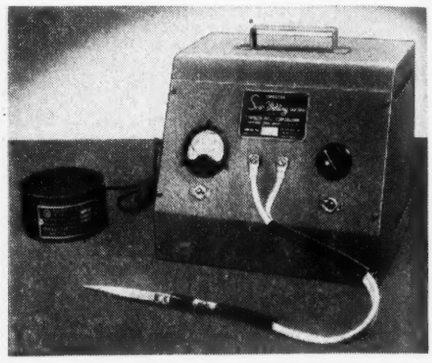
Shop Equipment & Materials

Tweezer Spot Welder.....49

Designed to weld parts from .0005 to ⅛ in. round, new "Besco" tweezer spot welder made by **Tweezer-Weld Corp.**, Newark, N. J., is portable unit weighing about 25 lb. A pair of insulated, forged copper tweezers and a foot switch are connected to cabinet which is size of small radio. It plugs into 115v. 60 cyc. power supply but is adaptable to 250v. To weld parts .015 through ⅛ in.



round, machine is used with auxiliary booster which increases capacity of equipment 300%. To weld, volt meter is set, two pieces to be joined are held with tweezers, pressure is applied, and current is turned on with foot switch. To weld some types of heavy gage metal, where more pressure is required, tweezers may be removed and machine connected to drill press or hard arbor, with copper rods inserted as electrodes.—**AVIATION, Apr., '46.**

Sealing Compound 50

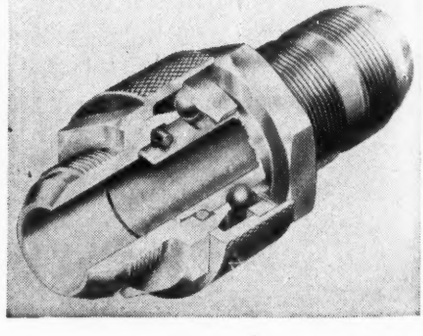
Stated to produce a high efficiency seal which is proof against air, water, steam, gas, gasoline, oil, hydraulic fluids, and aromatics, new thread and gasket sealing compound, known as "Uniseal", is announced by **Parker Appliance Co.**, Cleveland. Of paste consistency, product contains no free metallic particles or additives subject to washing out. Compound flows to form ribbon gaskets and blends with cut gasket material.—**AVIATION, Apr., '46.**

Collet Air Chuck.....51

By use of adapter sleeve, new size collet air chuck, known as No. 10, made by **Redmer Air Devises Corp.**, Chicago, will use regular No. 00 collets, but will increase capacity since new collets have size range from 1/16 to ½ in. This chuck is same size as present No. 00.—**AVIATION, Apr., '46.**

Hose Coupling 52

Designed for use on hose lines operating under pressure, new coupling announced by **Roylyn Mechanical Laboratory**, Los Angeles, is based on inclined plane and wheel principle. Three main parts are cam ring, ball and cage, and nipple. Rotating cam collar forces steel balls into groove in nipple forcing halves together. Gasket in ball cage provides seal as well as separating



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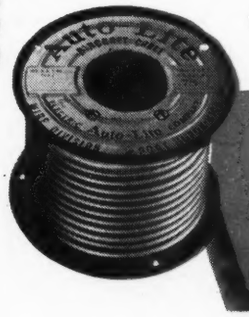

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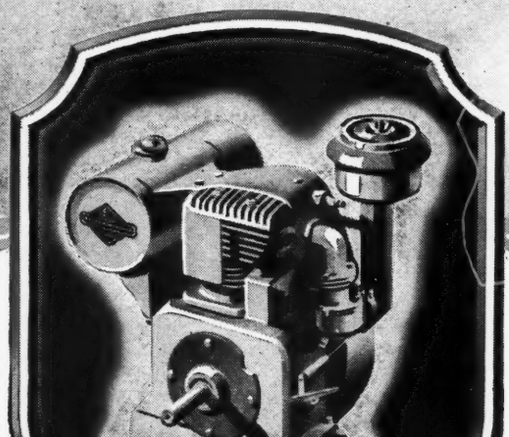

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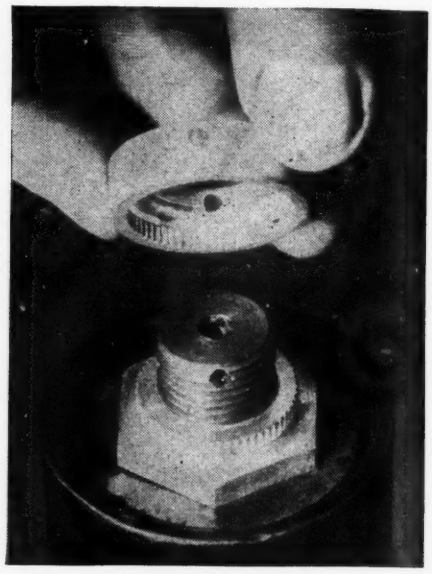
spring force necessary in operation of lock. Application of pressure tightens coupling. Maker states temperature operating range is from minus 650 deg. to plus 300 deg., with safe pressure limits of 1,680 psi. for 2 in. unit and 11,500 psi. for ¼ in. unit. Couplings are available in aluminum, brass, alloy, or stainless steel, with gaskets for fuels, oils, and acids. Units are made with flared tube connections or pipe threads. Standard thread sizes run from ¼ to 2 in. **AVIATION, Apr., '46.**

Precise Adjustment Nut.....53

Made by **E. S. Firestone Engineering Co.**, North Hollywood, Calif., new 60-station adjustment nut is stated to permit precision setting by use of matting serrations which allow nut to be set at desired tension and



locked in position. Adjustment is stated to permit micrometer settings to as low as .001 take-up on 16-pitch threads, with finer adjustments on threads with larger pitch. Nut is suitable for airplane wing bolts, transmissions, and instruments.—**AVIATION, Apr., '46.**

Arc Welding Electrodes.....54

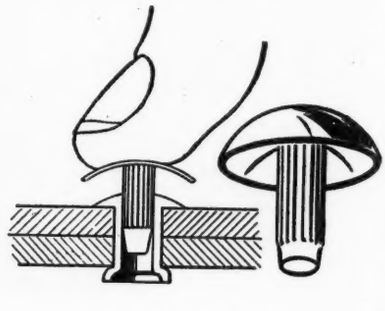
Stated to be first units to provide two complete series of all-position high tensile electrodes, one having AWS-ASTM XX10, type of coating and other AWS-ASTM XX13, new "Murex" arc welding electrodes, **made by Metal & Thermit Corp.**, N.Y.C., are applicable to variety of welding uses involving high tensile steel. There are eight electrodes in line, classified as AWS Grade E-7010, E-8010, E-9010, and E-10010 for use on d.c. with reverse polarity, and companion electrodes for each having XX13 coatings for use on a.c. or d.c. with straight polarity. Graduated alloying contents of chromium and molybdenum give electrodes their mechanical properties.—**AVIATION, Apr., '46.**

Paint Remover 55

Stated to be safe on aluminum, noninflammable, and fast, new paint remover made by **Kelite Products,** Los Angeles, is specifically suitable for removal of paint from aircraft. Maker states as many as eight coats of paint can be removed in one step.—**AVIATION, Apr., '46.**

Rivet Plug 56

Colored rivet heads to match color or texture of material are now available



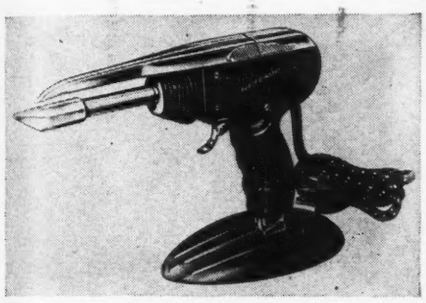
through use of "umbrella plugs" developed by **Cherry Rivet Co.**, Los Angeles. Plug fits into center of hollow-type rivets, forming cap completely covering rivet head. Aluminum, copper, or plastic plugs can be colored to match or harmonize with surrounding surface. Shank of plug is knurled and tapered. Pointed end is inserted into installed rivet and plug pushed in by hand. Plugs may be used in hollow rivets of 1/8, 5/32, 3/16, and 1/4 in. dia.—**AVIATION, Apr., '46.**

Concentrated Washing Compound....57

Stated to be chemically neutral with no adverse effect on skin, cloth, metals, or plastics, washing compound, BEX UT-30, made by **Graybex Corp.**, Nutley, N. J., is designed to meet aviation standards of safety. It is amber liquid which, when extended with 10 to 500 parts of water, is stable mixture. In some cases it may be used in concentrated form without risk. It weighs about 8 1/4 lb. per gal.—**AVIATION, Apr., '46.**

Electric Soldering Iron.....58

Trigger operated, and ejecting measured amount of solder from reel in handle, "Eject-O-Matic" electric soldering iron produced by **Multi-Products Tool Co.**, Newark, N. J., features special retraction



arrangement to prevent melting of excess solder on heating tip. Actual amount of solder deposited is regulated by micrometer adjusting wheel. Tool weighs 1 1/4 lb. loaded. When resting on stand (see photo), iron can be moved forward through angle of 45 deg., providing firm foundation for fine work.—**AVIATION, Apr., '46.**

Streamlined Gages 59

Stated to be superior in construction, appearance, and readability, new streamlined gages made by **United States Gauge Div., American Machine & Metals,** N. Y. C., have neutral gray cases and ivory toned dials with red and black graduations.—**AVIATION, Apr., '46.**

Miniature Ball Bearings 60

Shown here actual size is new series of miniature ball bearings made by **Miniature Precision Bearings,** Keene, N. H. Having outside dia. of 5/16 in. and bores of 7/32,

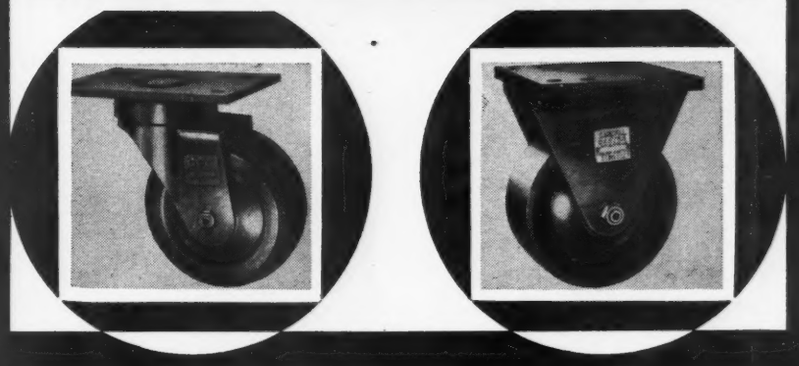
3/16, 5/32, and 1/8 in., they are made of chrome bearing steel and finished to tolerances of plus .0000 and minus .0002. They are designed for use in small motors and computers.—**AVIATION, Apr., '46.**

Electrical Appliances

Exciter and Calibrator.....61

Designed to deliver peak force of 200 lb. over a wide frequency range, new electrodynamic exciter and calibrator made by **MB Mfg. Co.**, New Haven, Conn., is stated to enable test operator to excite product or part to its resonant modes of vibration with a pure sine wave force that can be controlled in both frequency and amplitude, and provided is means of study-

DARNELL
CASTERS & WHEELS



Durable, precision-built Darnell Casters and Wheels assure the easy handling of heavy loads – savings in floor and equipment wear soon pay for their cost.

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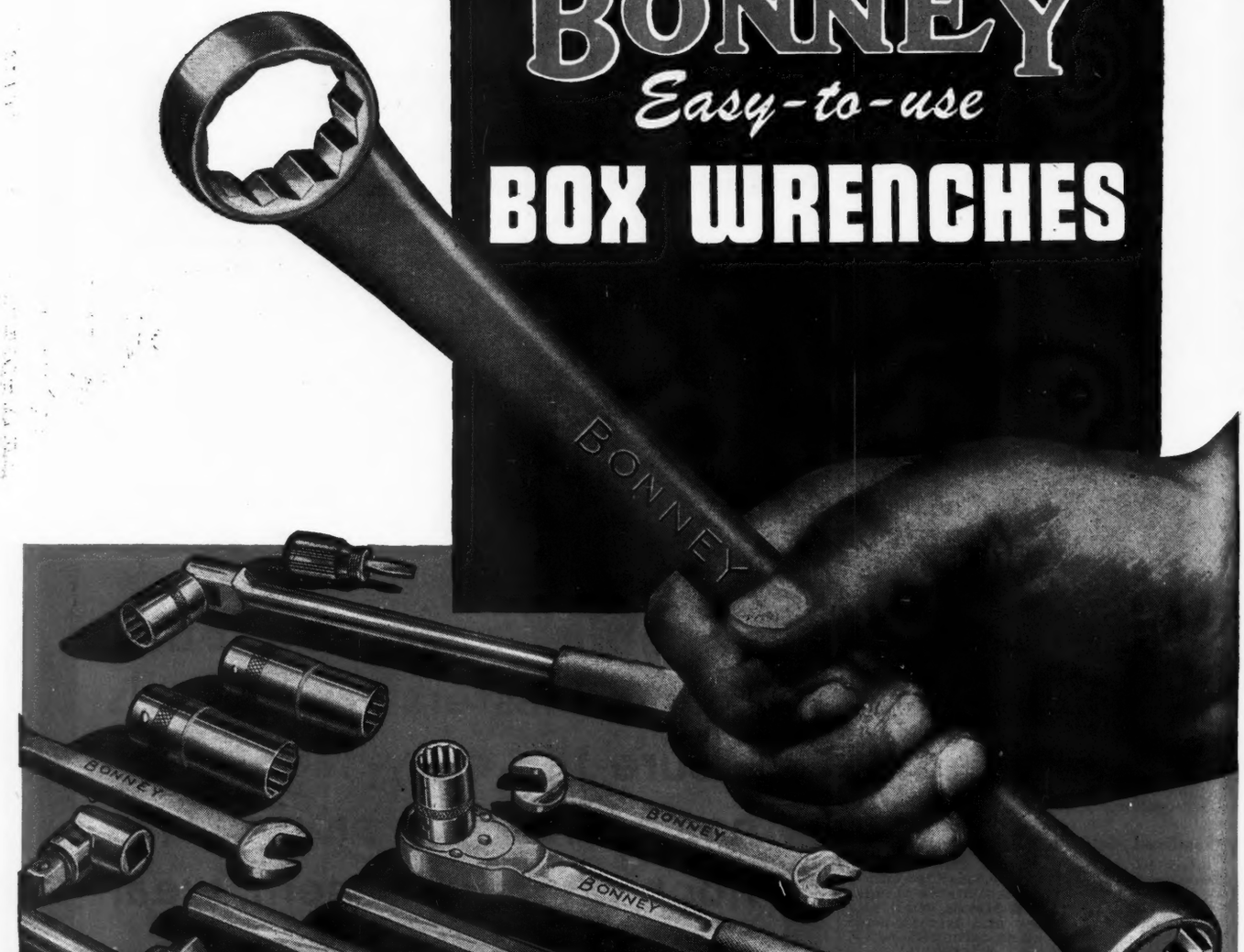
BONNEY

Easy-to-use

BOX WRENCHES



Everything that makes box wrenches easy-to-use—that makes them the way mechanics like them—you'll find in Bonney Box Wrenches. They are slim, light, well balanced. Their openings are set at a 15° angle and are pull-broached to exact size. They are drop forged from finest alloy steels and "custom" heat-treated. Be sure your box wrenches—and all your other tools—carry the name Bonney. Write for a copy of the new Bonney Tool Catalog. It will show you the complete line.

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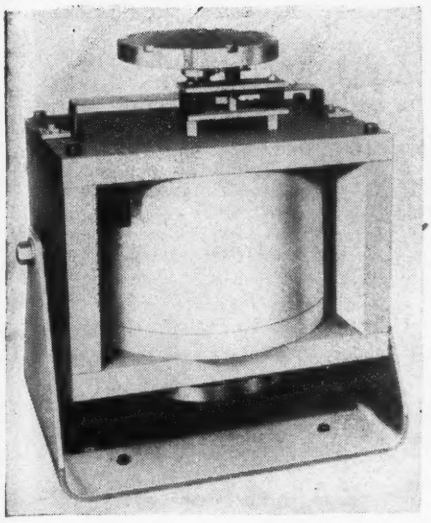
BUY VICTORY BONDS AND KEEP THEM



ing nature of modes. By vibrating mechanical structures and parts to destruction, unit points out weak spots, helps locate noise sources, and duplicates age-loosening of parts. It is stated that, when operating machine above, own mechanical resonance, vibration pick-ups (acceleration, velocity and displacement types) can be calibrated with wave form as good as that of current source. Rated accelerations as high as 20g. are produced, with a peak of 40g. for short periods. Maximum table travel is 1.0 in. Table is adjustable for motion in any direction. Weight is 685 lb. and dimensions are 23 x 24 x 14 in.—**AVIATION, Apr., '46.**

Dynamometer 62

Developed to replace prony brakes for measuring torque and hp. of fractional hp. motors, new dynamometer is offered by **L. A. B. Corp.,** Summit, N. J. Self damping, self cooling, and of eddy current type with d.c. excitation, unit is designed for uninterrupted service in testing electric, hydraulic, pneumatic, and internal combustion motors. They have no springs or frictional devices. Unit is made in sizes to measure torque from 10 oz..-in to 25 in.-lb. —**AVIATION, Apr., '46.**

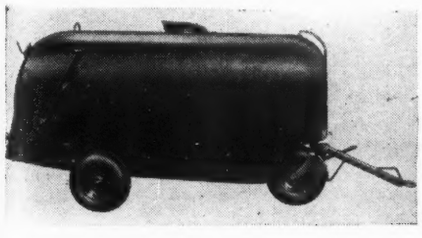
Crystal Diodes 63

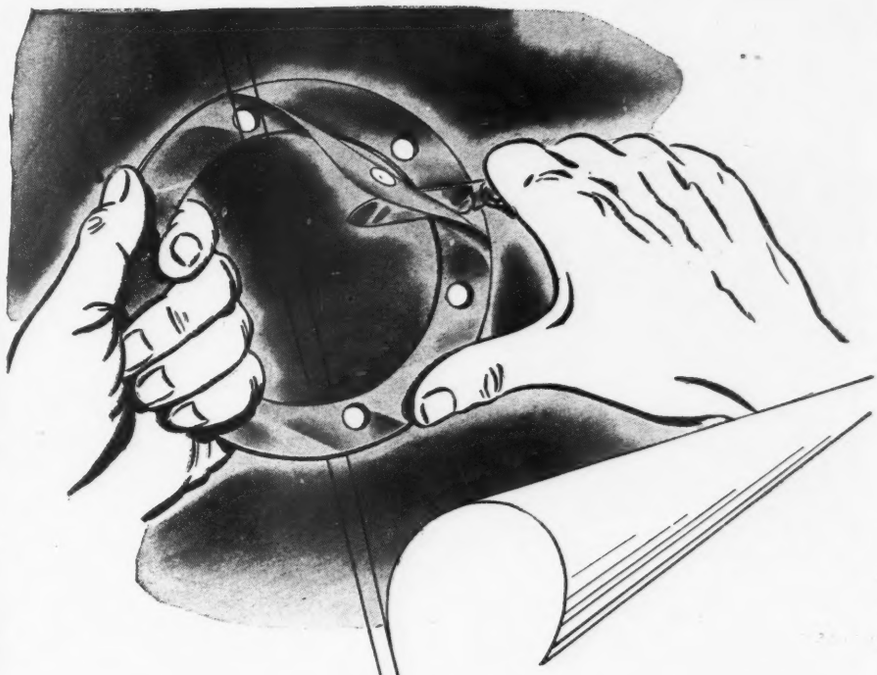
Supplied in cartridges measuring .75 x .25 in., and requiring no heater supply or adjustment, germanium crystal diodes made by **Sylvania Electric Products, Electronics Div.,** Boston, have applications to volume limiters, square wave clippers, varistors, noise silencers, meter rectifiers, and volume expanders and volume contractors. They are also used as second detectors and d.c. restorers, frequency discriminators, first detectors, modulators and demodulators, low frequency oscillators, voltage regulators, and polarizing devices. —**AVIATION, Apr., '46.**

Aircraft Parts & Field Units

Gasoline Dispenser 64

Developed for airfields, portable aviation gasoline dispenser, "Fuel-A-Plane", made by **Harman Equipment Co.,** Los Angeles, has two-way suction manifold permitting pumping from tank to trailer to plane.





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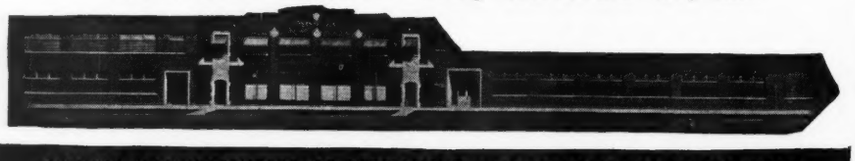

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ANNOUNCEMENTS—

of new machinery, shop equipment and materials, electrical appliances, and aircraft parts and field units are invited.

In writing, emphasis upon specific aviation applications of newly marketed items is desirable. Also, whenever possible, glossy-print photos should be enclosed. Please do not send electros. Address—

New Products Editor, AVIATION
330 W. 42d St., New York City 18

Gasoline is decontaminated and purified. Unity pumps fuel at 15 to 18 gpm. Additional pressure release area is provided by 6-in. hinged self-locking cover, fitted with triplex vent, padlock receptacle, and spring loaded at 3-lb. pressure. Tank outlet is equipped with fusible links and dual control rod to permit closing from front or rear. Storage space is provided for oil cans. As gasoline is delivered, it goes through water separator, air eliminator, strainer, and visible-flow glass and meter. Unit is built on pneumatic-tired three-wheeled trailer having rack for coiling hose at rear of dispensing compartment. Also supplied are 25 ft. of 1 in. rubber hose, nozzle which shuts off when pump stops, static cable with clamp, and 1-qt. fire extinguisher. Trailers or self propelled units, designed for one-man operation, are made to carry 2 to 4 barrels or tanks from 125 to 330-gal. capacity.—**AVIATION, Apr., '46.**

Electrical Gyroscope Instruments....65

New electrically driven directional and bank and climb gyroscopes made by **General Electric Co.,** Schenectady, New York,

each require but 3¼ in. of space on instrument panel. Directional gyro saves more than 1 lb. weight, in comparison with one replaced, and bank and climb gyro weighs 33½ lb., as compared with 9 lb. of former unit.—**AVIATION, Apr., '46.**

Twin-Valve Fuel Pump.....66

Commercial airlines are now reported testing new dual valve unit, developed by **Candler-Hill Corp.,** Detroit, stated to deliver a constant flow of fuel at almost constant pressure and volume. This is accomplished, states maker, by a development in relief valve design incorporating two relief valves within the mechanism. Working on a common guide pin, dual valves balance each other. They are now made in capacities of 830 and 1,600 gph. at 2,500 rpm.—**AVIATION, Apr., '46.**

Engine Timer 67

Engine timing by direct measurement of piston travel is accomplished by new Model B "Time Rite" made by **Gabb Mfg. Co.,** East Hartford, Conn. Designed for use on all aircraft engines, its features a slide pointer, automatically referenced, and an adjustable calibrated scale. These are stated to eliminate need for finding top

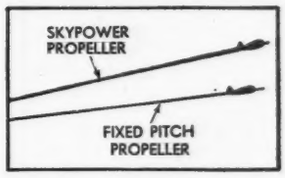
A HYDRAULICALLY OPERATED CONTROLLABLE PITCH PROPELLER FOR LIGHT PLANES

Now, your plane can have shorter take-offs, faster rate of climb, and higher ceiling—improved performance factors made possible by the new Continental Aviation Skypower Propeller, a hydraulically operated controllable pitch propeller for light planes. The Skypower Propeller is simple in design and operation, and has been tested and proved in thousands of miles of flight. If your new plane or your present plane is powered with a Continental A-65 or C-75-85, your base operator can install a Skypower Propeller quickly, at low cost. For literature and details, write Continental Aviation and Engineering.

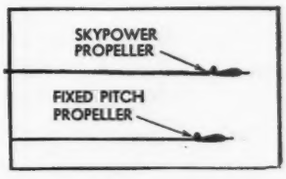
THE SKYPOWER PROPELLER IS THE 'GEAR SHIFT' OF YOUR PLANE! NOTE THESE ADVANTAGES:

- SKYPOWER PROPELLER operates hydraulically from the regular engine oil pump. Hydraulic actuator is stationary — no spinning parts — no packing glands or gaskets to leak.
- SPECIALLY DESIGNED laminated birch blades for greatest efficiency.
- PUSH-PULL control on panel shifts prop for take-off or cruise.
- POSITIVE hydraulic action sets Skypower Propeller in either position.
- SIMPLE DESIGN results in light weight.

SHORTER TAKE-OFF A high-performance plane with C-85 engine and the **SKYPOWER PROPELLER** reduces take-off runs as much as 20% or more. It utilizes the Continental engine's full take-off power rating.



RATE OF CLIMB increased by as much as 27% or more with the **SKYPOWER PROPELLER.** You can fly from smaller fields or shorter landing strips.



With given load, the **SKYPOWER PROPELLER** increases the ceiling or increases load capacity at former ceiling.

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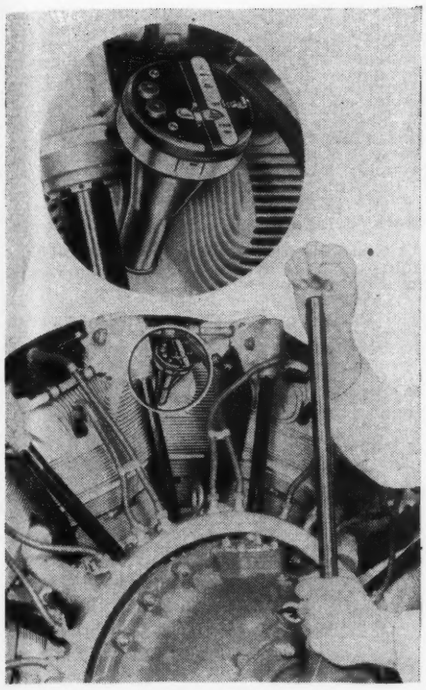


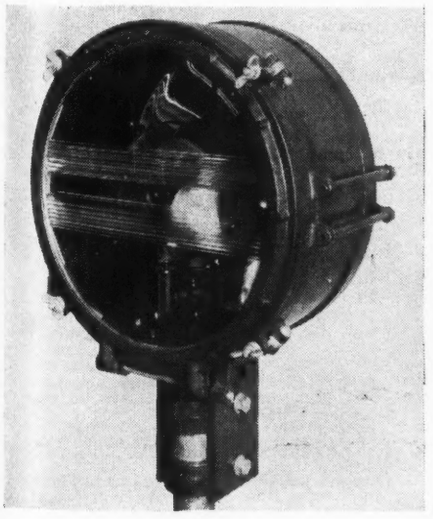
dead center and compensation for variables. In addition it may be used for magneto point synchronization. Kit includes case, supplemental battery supply, battery leads, magneto synchronizing leads, and instruction book. Manufacturer-approved scales are available for all types of engines.—**AVIATION, Apr., '46.**

Airplane "T" Hangar.....68

Available for both large and small planes, "Silver T", new type airplane hangar, has been designed by **Airport Facilities Corp.**, Chicago. All aluminum, hence requiring no paint, it is made in low arched sections and shaped like a cross. Hangar doors are eliminated by having sections roll out on rails 15 in. off ground, leaving tail of plane enclosed. Rails are enclosed to protect against ice and snow. Pilot may warm up plane where it is before taxiing to runway. Nearly all prefabricated, hangar can be assembled on spot it will occupy. Other features are: Wing sections rolled on electrically heated rails and having heated joints for all-weather protection; planes automatically spotted in hangar in working position under skylights; electric lights installed for working at night; overhead trolley crane provided for heavy work; and power operated platforms suspended from walls. Floor is unobstructed, although multi-plane models are compartmented for convenience and fire protection.—**AVIATION, Apr., '46.**

Airport Approach Light.....69

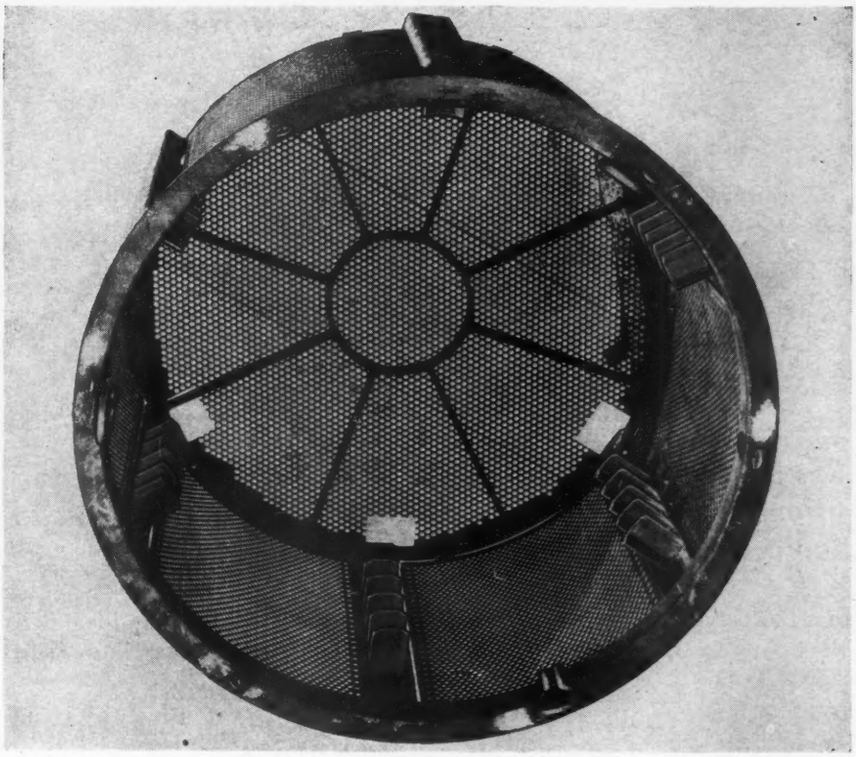
Using 19-in. reflector-lens system with special 250w. lamp, new searchlight-type



LIGHTWEIGHT, STRENGTH AND CORROSION RESISTANCE IN THIS

Annealing and Heat Treating Basket

Made by The Pressed Steel Company



Although this large Annealing and Pickling Basket is 6 ft. in diameter and 6 ft. high, its initial cost is *low*. It is fabricated and welded from light gauge alloy steels that will outlast much heavier and more costly cast alloy equipment many times. It is light but strong, and will withstand corrosion.

May we quote on your large equipment or on your more ordinary needs?

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Carburizing and Annealing Boxes, Thermocouple Protection Tubes, Seamless Steel Cylinder Caps, Seamless Steel Neck Rings, Welded Alloy Tubing for High Temperature and Corrosive Applications, Radient Tubes, Inner Covers and Base Sheaths for Steel Mills.

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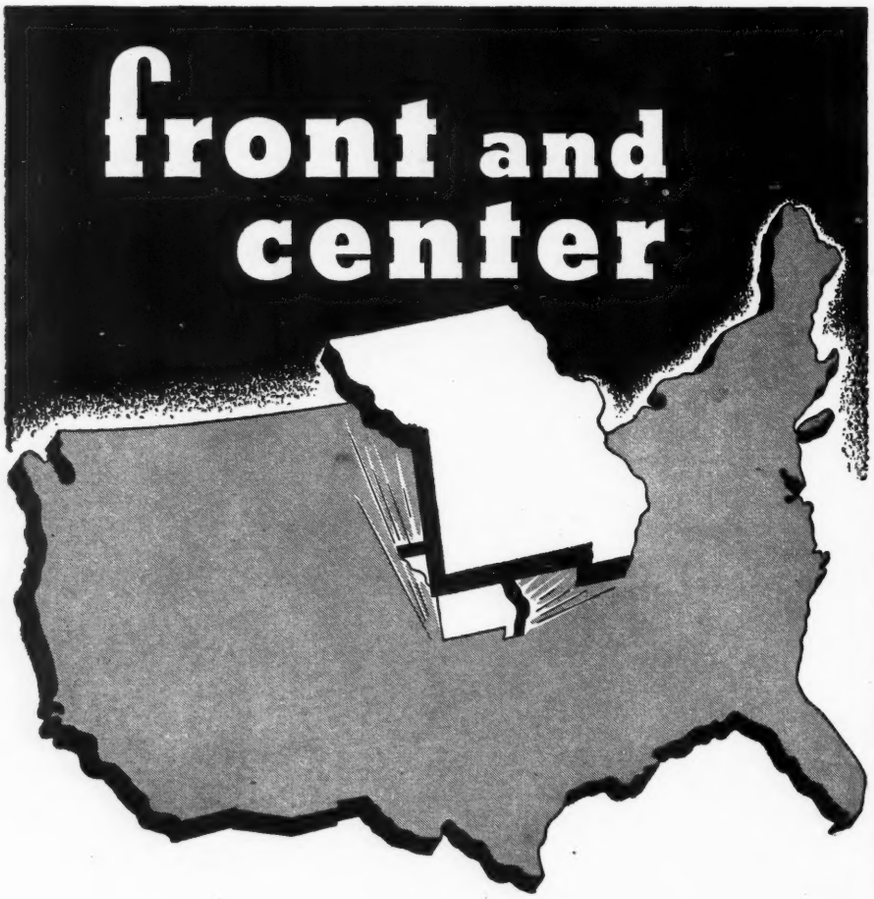

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THE STATE OF MISSOURI
IN THE HEART OF AMERICA

approach light for use with blind landing systems is announced by **Westinghouse Electric Corp.**, Pittsburgh. Unit has main beam of 1¼ million cp., aimed directly along path of approaching plane, and auxiliary fan beams (of over 100,000 cp.) which reach from ground to angle far above plane. Mounted on each side of approach zone and spaced 500 ft. apart, 2,500-ft. rows of light provide half-mile of direct visibility in "soupiest" weather, maker states.—**AVIATION, Apr., '46.**

Radio Telephone 70

Adapatable for use in planes, new mobile radio-telephone system developed by **Western Electric Co.**, N. Y. C., will make contact with any phone reached by Bell system. To make call, flyer removes handset, gives operator number, presses button in handset while talking, and releases it while listening. To make call to vehicle or plane, airman asks for "mobile service operator." Each plane would have individual number so only bell being called would ring. Equipment consists of radio transmitter, receiver, control unit, antenna, and cable. Operating power for unit is heavy-duty 6 or 12v. battery with oversized generator. Standby power is 60w.—**AVIATION, Apr., '46.**

Approach-Angle Projector 71

Using 100w. incandescent bulb to project tri-colored beam over a 1-mi. range, new approach-angle indicator is announced by **Westinghouse Electric Corp.**, Pitts-

burgh. It sends light through seven lenses, breaking it into green, red, and amber beams. Beams flash on for 1 sec. and off for ½ sec., and they are controlled by motor driven shutter. For larger airports, 250w. lamp is available, giving about 3-mi.-range.—**AVIATION, Apr., '46.**

Luminous Exit Disks.....72

For marking emergency exits, and for other aviation applications, **Pako Photo Service Co.**, Minneapolis, has developed luminous identification disks which glow in dark. Fitting over recessed handle of emergency exit door, plastic disk, coated with phosphorescent paint, glows with blue light. Directions for opening door are printed on luminous side. Material is available in tape form for marking parachute locations, flight controls, fire extinguishers, wing tips, and other locations.—**AVIATION, Apr., '46.**

Parachute Harness 73

Now available to civilian flyers and flying schools, new commercial-type parachute harness is announced by **Pioneer Parachut Co.**, Manchester, Conn. It is stated it can be donned and adjusted on any wearer in 3 sec. To put on, chest and leg straps are snapped on in usual way. A tug at leg and chest straps draws harness to a fit.—**AVIATION, Apr., '46.**

Cargo Conveyors 74

Having application to aircraft cargo handling, packaged line of gravity roller conveyors made by **Lyon Metal Products,**

What Mo[tor] INTEREST YOU?

Here are a few of the more than 3,000 applications for which Lamb Electric Motors have been used.

- Aircraft Components
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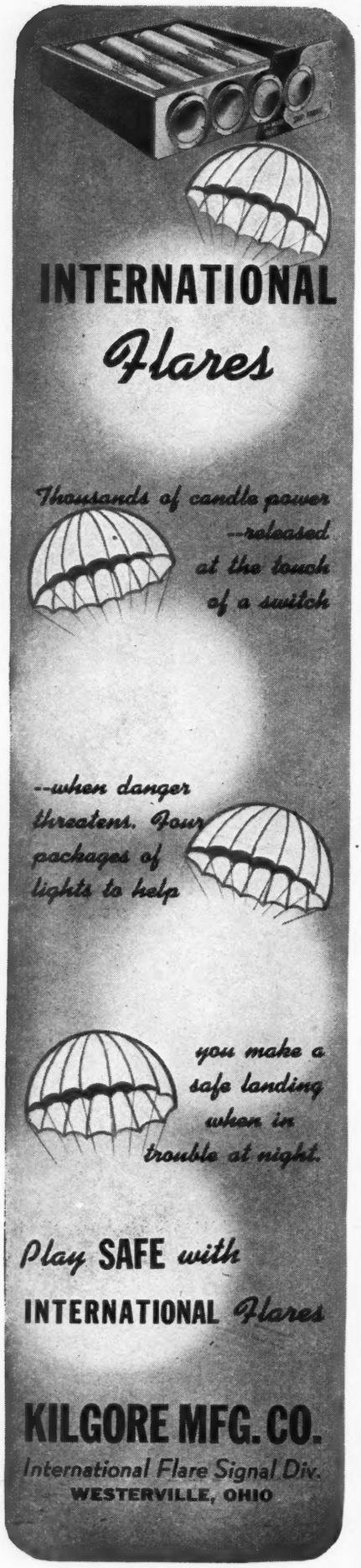
Small, sturdy motor that can be readily adapted to a wide range of industrial applications.

Black & Decker Electric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you make a safe landing when in trouble at night.
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Aurora, Ill., are available in these sizes: Three straight section 10 ft. long and 12, 18, and 24 in. wide; three 90-deg. curved sections 12, 18, 24 in. wide; and two trestles 18 and 24 in. wide. Each item is complete unit, and there are several arrangements of units in runs or curves. Conveyors will accommodate loads wider than conveyor section, and trestle supports are well braced for weight, yet light enough to move about. Conveyors, regardless of width, carry loads up to 200 lb.—**AVIATION, Apr., '46.**

Recent Books

PRODUCTION ILLUSTRATION, by John Treacy. John Wiley & Sons, New York City. 202 pages, drawings, index. $4.00.

Comprehensive and well-illustrated exposition of the techniques and applications of perspective engineering drawings. The subject is treated in two main parts: First, the actual preparation of production illustrations—the drafting, shading techniques, perspective methods, reproduction aids, and various finesses and short-cuts of the trade; and second, the introduction and practical application of illustration to the problems of industrial production.

BUILDING A SALES TRAINING PLAN, by Edward J. Hegarty. McGraw-Hill Book Co., New York City. 198 pages. $2.00.

A new approach to sales training, offering practical rules for building and operating a successful sales training program. Discussed are basic selling-training principles, with specific suggestions drawn from wide field experience for putting these principles into practice. Also covered are the many recent developments in the training field, such as new methods for guiding returned military personnel into the sales fields.

WHY? Subtitle: WHY HAS AMERICA NO RIGID AIRSHIPS?, by P. W. Litchfield and Hugh Allen. Corday & Gross Co., Cleveland. 143 pages. $1.50.

Discussion of the controversial airship question, giving history and background of the great dirigibles, detailing the achievements of their designers, and putting forth the civil-flying theses of the lighter-than-air men. Contention is that the big airship offers notable advantages for long-distant passenger and cargo services, hence should be made a teammate with the steamship and airplane in the new civil transocean operations.

SYMPOSIUM ON MAGNETIC PARTICLE TESTING. American Society for Testing Materials, Philadelphia. 122 pages. $1.25.

This volume comprises eight technical papers on magnetic particle testing presented at a meeting of the Philadelphia District ASTM. Included are two ASTM methods for this testing and inspection of commercial steel castings (A272) and of heavy steel forgings (A275). The symposium discussions of the subject are also provided.

SHOP TERMS. Syracuse University Press, Syracuse, New York. 106 pages, illustrations.

Prepared by the Department of Education of the International Business Machines Corp., this book has been planned to meet the needs of industrial workers for a comprehensive reference manual of shop terms. A guide to pronunciation accompanies the text. Profusely illustrated.

RADAR, by Orrin E. Dunlap, Jr. Dunlap, Harper & Brothers, N. Y. C. 208 pages, glossary, bibliography, index. $2.50.

Popularly written account of radar, tracing the history of this science from the early reflected-wave experiments of Hertz and Marconi, through the application of the radio echo to so-called push-button warfare. Operation of radar is described in its ramifications, and the volume closes with a cogent discussion of the future of radar.

AIRCRAFT ELECTRICITY FOR THE MECHANIC, by Charles Edward Chapel. Coward-McCann, Inc., N. Y. C. 477 pages, illustrations, index. $5.00.

Lieut. Chapel initially explains fundamental principles of operation, maintenance, and inspection in the aircraft-electric fields. He then emphasizes the troubles most frequently encountered in actual operation, the various possible causes of these trou-

HANGAR FLYING

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PILOT-BOOSTER

Few people know that at one curious stage in the development of the *Constellation*, the plane's hydraulic booster system worked *too* well.

The plane was designed so that the boosters, instead of the pilot, would do most of the work moving the control surfaces. For every pound of push the pilot puts on the rudder pedals, for instance, the booster now exerts 23 pounds of pressure to move the rudder. Saves the pilot a lot of wrestling. And assures really full control of big, modern four-engine airliners.

Well anyway, early in the game Lockheed perfected the booster system to such a point that you could practically fly the *Constellation* with your little finger. This reaction, of course, was too sensitive for general use...but the point is that the all-important "feel" of the ship has been tailor-made to the exacting wishes of experienced pilots, who swear by it.

Now, to passengers and pilots, the *Constellation* acts like the thoroughbred she is. Her foolproof booster system (the only one with a C. A. A. approved type certificate) makes the 45-ton, four-engine plane handle as lightly as a twin motor job.

Like everything else on this ship, the boosters were developed by imaginative, painstaking engineering...the kind that keeps Lockheed leading the field.

L to L for L

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This informative index describes and classifies outstanding training films . . . tells which are free . . . which can be rented or bought, and for how much . . . and where to get them. For your copy, write . . .

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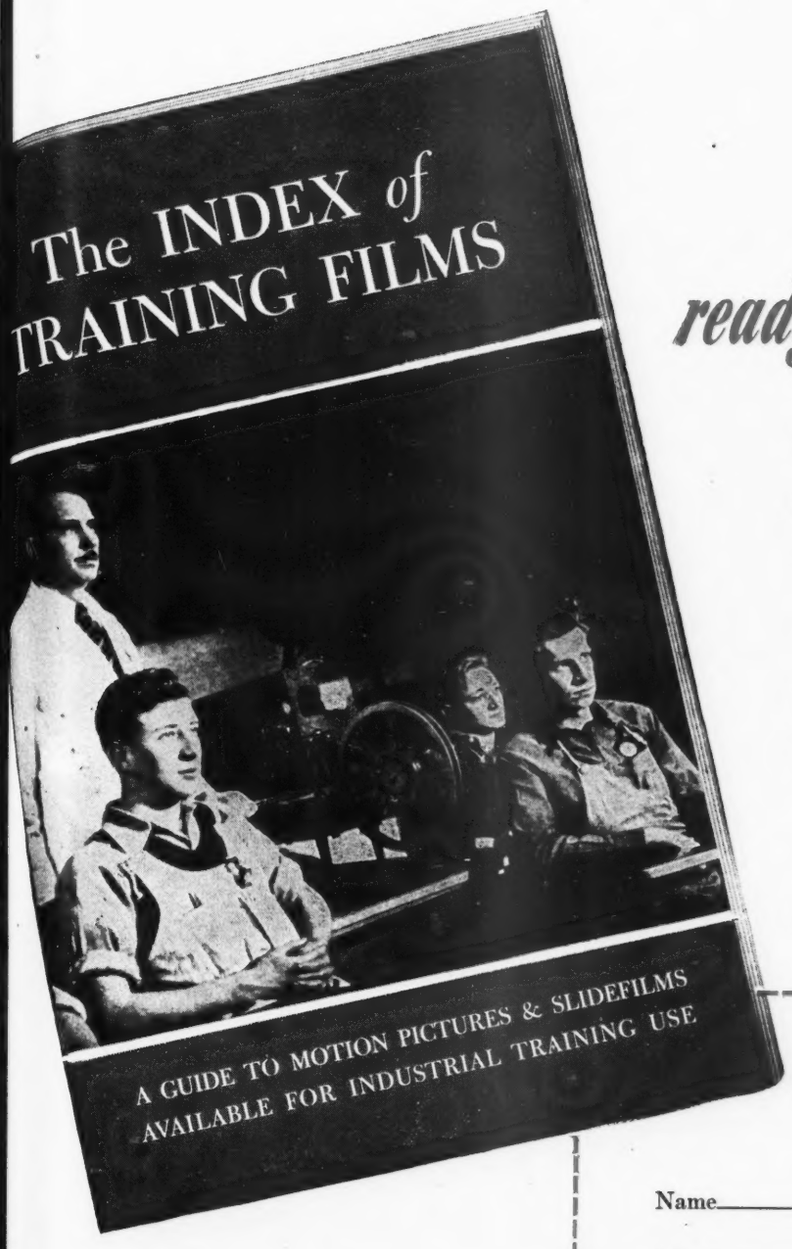

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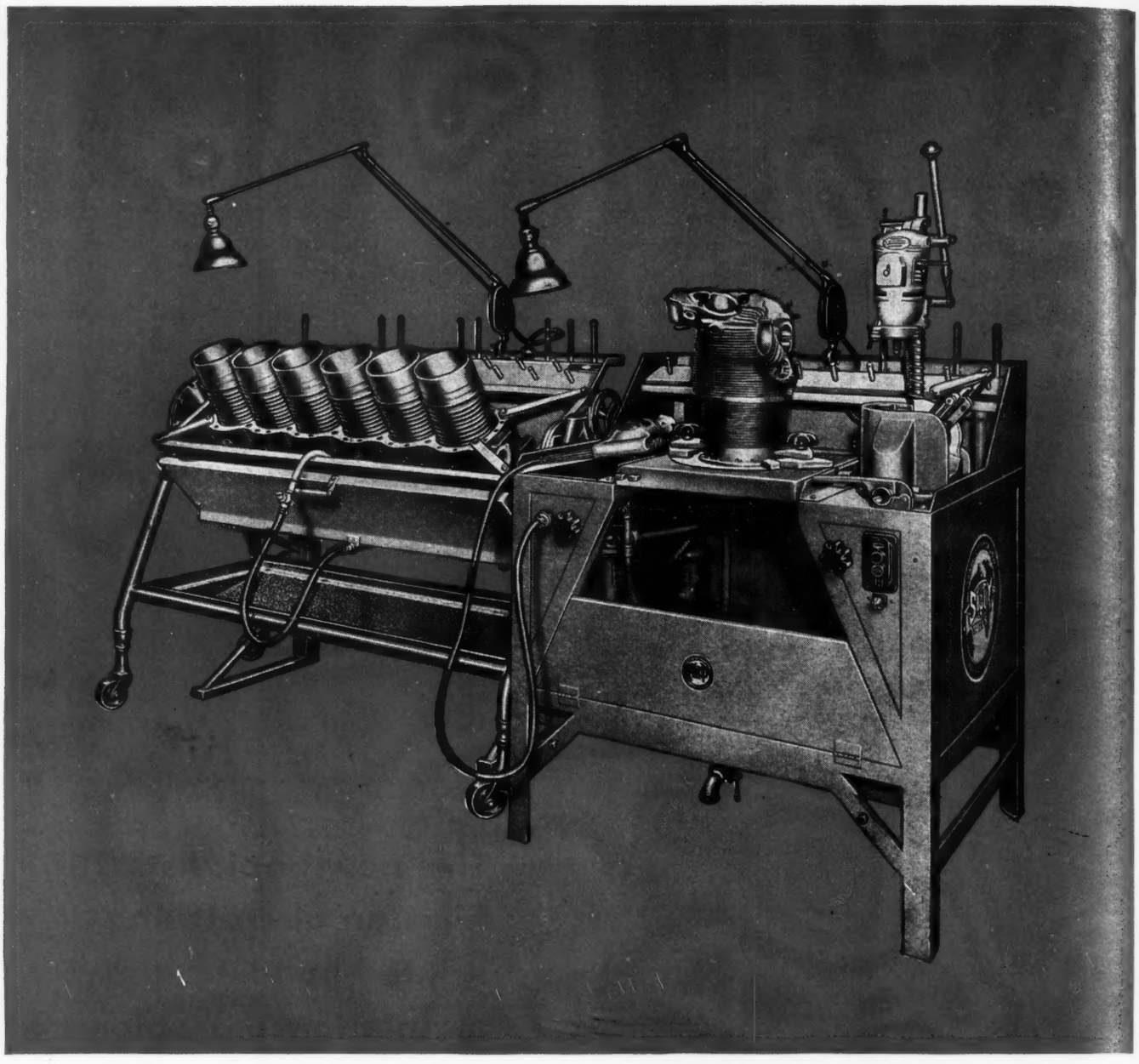

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is on its way!

When you think of radio for your plane, investigate the Raytheon Radiophone. Note its light weight, its many distinctive points of difference, its utter simplicity, its outstanding features. You'll agree that it's a private pilot's dream come true.

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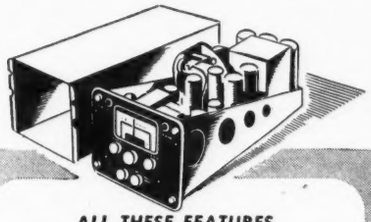

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bles and the symptoms by which they can be recognized, and finally he details the necessary corrections. The book is illustrated with many charts, diagrams, and pictures. Typical examination questions, with keys to correct answers, are found at the end of each chapter.

FUNDAMENTALS OF AVIATION, by Henry Lionel Williams. The New Home Library, Blakiston Co., N. Y. C. 282 pages, illustrations. $1.00.

Comprehensive, clearly written presentation of the basic factors of air transportation and private flying. Beginning with man's conquest of the air, the author traces development of the airplane to the present day, weighs problems that still await solution, and explores future possibilities.

THE AIRCRAFT ANNUAL, 1946, by David C. Cooke. Robert M. McBride Co., N. Y. C. 304 pages, photographs. $3.00.

Latest edition of this annual series of reviews on modern aviation. Following key pattern of its predecessors, the volume affords a well-rounded picture of what's new in world aviation.

AVIATION—THE HOME UNIVERSITY LIBRARY. H. E. Wimperis. Oxford University Press, N. Y. C. 184 pages, appendices, index. $1.25.

Scholarly discussion and analysis of world aviation in its overall phases by British authority.

PRACTICAL AIR NAVIGATION (Civil Aeronautics Bulletin No. 24). Thoburn C. Lyon. U. S. Government Printing Office, Washington, D. C. $1.00

In this new edition, the entire text has been revised and several new chapters have been added, including one on polar avigation. In addition, an entire chapter has been devoted to special problems of dead reckoning. (Climb, descent, radius of action, interception, etc.). There is also a comprehensive chapter illustrating use of computers (the Simplified Flight Calculator, Mark VII, E-6B, and Mark 3A Plotting Board).

INDUSTRIAL ALGEBRA AND TRIGONOMETRY, by John H. Wolfe, William F. Mueller, and Seibert D. Mullikin. McGraw-Hill Book Co., N. Y. C. 389 pages, tables, illustrations, index. $2.20.

This volume offers practical training in applying mathematics to the solution of typical mechanical and electrical engineering problems in modern industry. A special feature is the classification and duplication of problems as needed to assure mastery of principles. The work should prove of interest to aviation personnel involved in engineering and allied phases.

INDUSTRY PUBLICATIONS

To Aeronca dealers and distributors is going what is termed first complete accounting manual offered by personal plane industry. Given are accounting instructions, chart of accounts, and illustrated forms. . . . "What is Different About Atlantic Airlines' Area Service and Why?" is name of this airline's brochure prepared for CAB hearing. . . . "Sea-Air Issue", is a study of controversy on whether U.S. flag steamship lines shall be allowed to operate airline services in connection with their regular ship routes. It's available from Sea-Air Committee, National Federation of American Shipping, 2660 Woodley Rd., N.W., Washington, D. C. . . . "Report to the Members of the Air Power League", discusses League's progress and projected activities for '46. . . . "Carelessness—The Principal Factor in Ground-Fire Accidents", is CAB Safety Bureau Bulletin No. 168-46. . . . "Liquidation of War Surpluses", is quarterly report to Congress by SPA. . . . "Wings over America", is Public Affairs Pamphlet No. 114, discussing future of air power. It's available for 10¢ from Public Affairs Committee, 30 Rockefeller Plaza, N.Y.C. . . . "George Westinghouse—His Life and Achievements", is presentation by company on its centennial relating pioneering work started by founder. . . "DuPont's Part in the National Security Program" itemizes company's diverse activities in developing materials for industry. . . "Steel in the War", is well-illustrated account of industry's part in supplying metals to aviation and other specialized industries. It is available to libraries as an industrial reference volume. . . . "Use Your Ranger Radio Correctly" is new manual being distributed by Ranger Aircraft Radio Div., Electronic Specialty Co., Los Angeles, containing suggestions helpful to personal pilots on correct phraseology, phonetic alphabet, and Morse code. Included is a section on flying radio ranges.

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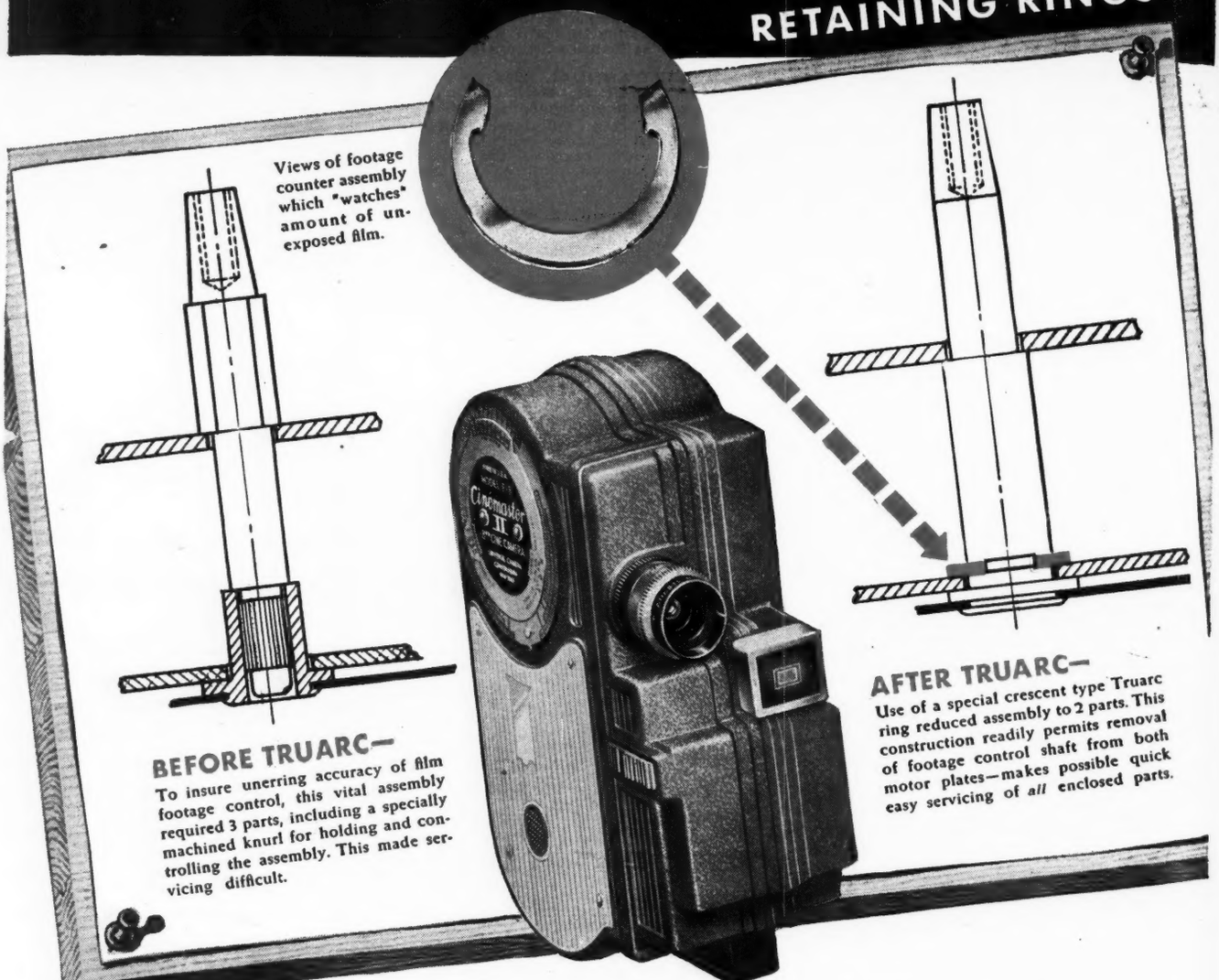
Views of footage counter assembly which "watches" amount of unexposed film.
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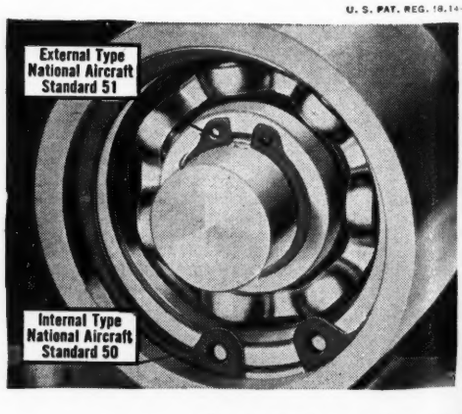

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Future in Aero Securities

(*Continued from page* 53)

Some former holders of United Aircraft common stock may have switched to the company's senior stock following the common dividend reduction last year.

Table II, giving the purchases and sales of aviation stocks by reporting investment companies during 1945, indicates that there was fairly heavy selling in both the airline and aircraft manufacturing stocks. In fact, this profit-taking, particularly in the case of the aircraft stocks, more than offset new purchases.

Among the general investment trusts Lehman Corp., with $2,668,700 worth of aviation securities at the end of '45, probably has the largest aviation holdings of any concern of its type. Then there are the aviation investment companies offering a field for investors who want broader representation in the aviation sphere. National Aviation Corp., which is highly regarded in the financial district because of its able management and successful record, has held a widely diversified portfolio of aviation securities, the market value having run to $11,413,000 at the end of 1945. It's notable that this company disposed of all its rubber, automotive, electric, and oil holdings during 1945.

Air Investors, now in its 19th year, held aviation securities valued at $549,000 at the end of 1945, along with $1,303,000 worth of other industrial and government securities, while Aeronautical Securities, Inc., had investments with a market value of $1,100,850. Moreover, Aviation Group Shares of Institutional Securities, Ltd., provides investors with representation in a group of leading airline and aircraft shares. And Adams Express Co., one of the larger investment trusts, holds a large indirect interest in aviation stocks through holdings of 15,700 shares of National Aviation Corp., valued at $416,000.

All-In-One Mapigator

(*Continued from page* 50)

justable "graphic wind arrow", pivoted on top of the coversheet; and a flight log surfaced for writing. There also are a circular computer, a pencil holder, and a scale for estimating distance by eye.

Operation of the device is comparatively simple. Following selection of the proper map, which may be either a regional, sectional, or radio direction finding chart, the map is first folded into either a square or a strip to show the area of the flight, or legs of it, and then it is inserted between the baseboard and transparencies. The map can be inserted at the top, bottom, or sides. The grid disk should cover the part of the map to be used, and the map is aligned with North on the compass rose by adjusting with the meridians parallel to North and the grid disk lines parallel to the meridians. The map is then in place and the thumbscrews are gently tightened. Bulldog clips secure tucked-under portions of the map that may protrude.

The course can be plotted directly upon the coversheet using an ordinary pencil, and check points may be marked. The grid disk may be used as a guide in drawing lines. All markings made on the coversheet can be easily erased.

Direction and distance are both measured by using the grid. To determine direction, the grid disk is rotated until two points are connected by, or are closely adjacent to, the same line. Direction may then be read on the compass rose at the radius parallel to the connecting lines. The reciprocal direction can be read on the opposite side of the rose.

Measuring distance is also very simple. The lines on the grid are $\frac{1}{4}$ in. apart and each fifth line is darker. Distance from one heavy line to the next equals 10 mi. on a sectional map, and 20 mi. on a regional. By counting the number of such lines crossed from one point to another, mileage may be quickly computed by the airman.

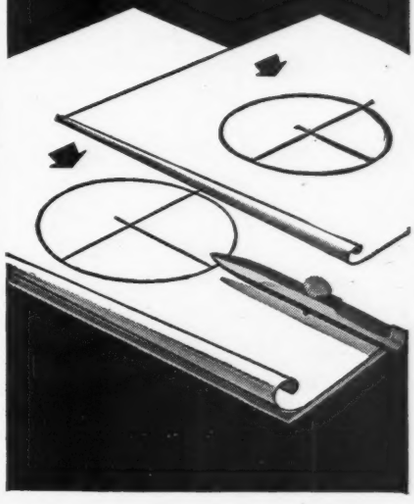
Wind-triangle problems may also be solved. The adjustable wind arrow may be set for wind velocity and direction, thus giving one side of the triangle. Since the length of each side of the triangle represents a speed in miles per hour, the following scale is used on the Mapigator: If the plane's speed is not over 120 mph., and if the wind is estimated at less than 30 mph., the space between two adjacent concentric circles equals 5 mph. With a faster plane or greater wind, this space is equal to 10 mph. The disk has three radii. The radius in the center of the ruled half is used for reading track and heading, thus giving the complete triangle.

Speed, time, and distance problems can be readily solved on the standard computer provided in the lower right-hand corner. The flight log (upper right) has room for rather complete data for planning up to three legs of a flight, and it emphasizes the use of checkpoints.

The Mapigator, designed so that it can be used with one hand, can be rested conveniently in the pilot's lap or be installed to slide out from beneath the instrument panel. Its graphic vizualization of common avigational problems would seem to make it equally adaptable for simplifying ground school training or home study.

It is stated that negotiations for manufacturing and marketing the device are now underway, hence it should soon be available to the flying public.

Tracing cloth that defies time



● The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

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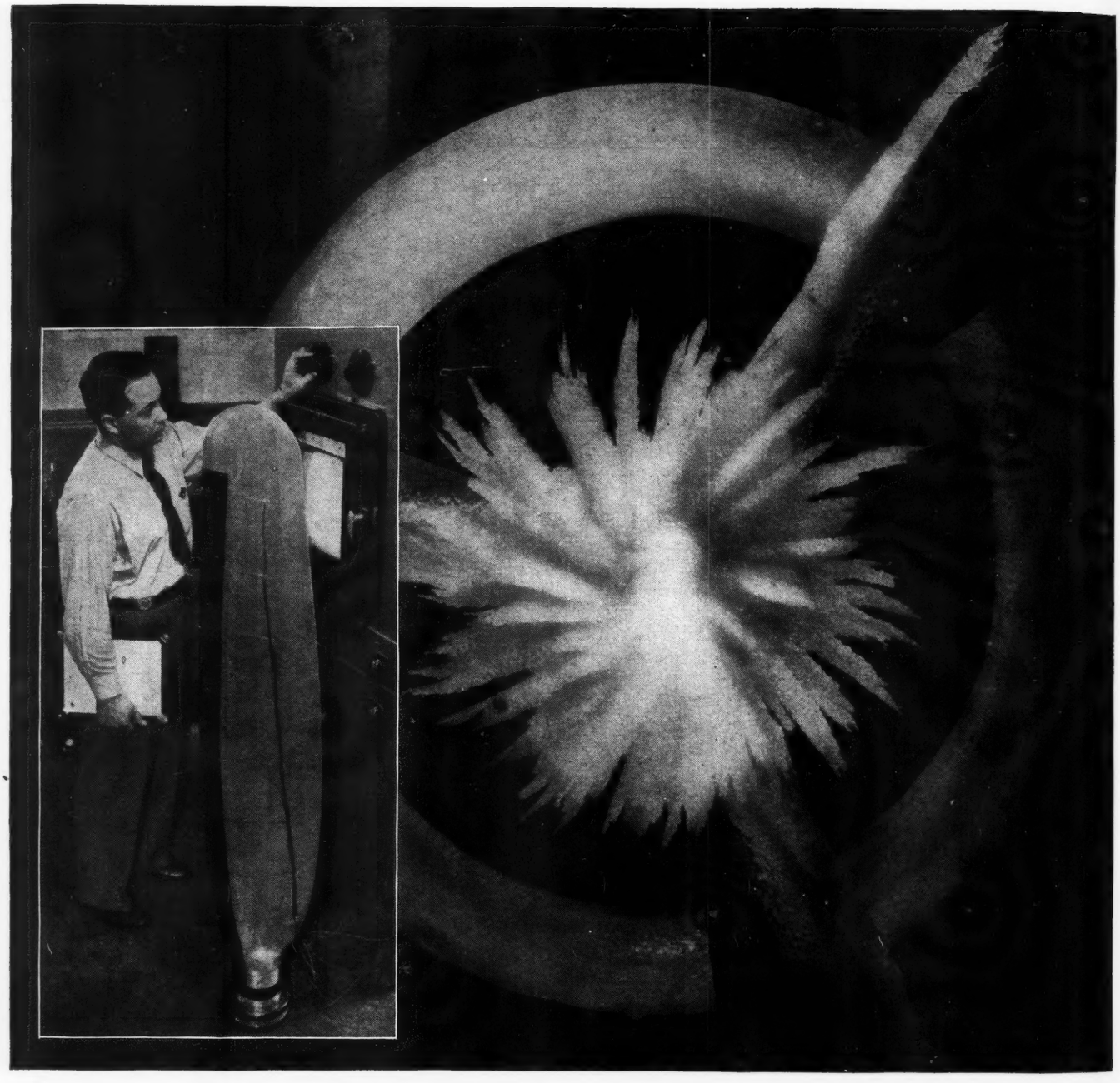

Push-button defrosting for planes

AN 80-MILE WIND, roaring through the B. F. Goodrich refrigerated wind tunnel, created the Jack Frost effect on the propeller model above.

The exaggerated ice flower on the hub isn't as serious as it looks; but fingers of ice, creeping up the blades, were a big worry to pilots for years. For in flight, ice on the blades means loss of power, bad balance, and excessive vibration.

To a pilot, the smaller picture looks a lot better. It's a propeller equipped with a new B. F. Goodrich development called an electrically heated propeller shoe. It's shown here being tested (the wires are part of the testing equipment; they are not on the blade in flight).

With these shoes on his propeller blades, a pilot can defrost them as simply as a housewife defrosts a refrigerator . . . and lots quicker. The pilot just touches a switch and electric current begins to generate heat in the shoe, which melts off ice.

B. F. Goodrich equipment protects many other parts of the airplane from ice. Best known are the De-Icers, which crack ice off as it forms on wings and tails, keeping these surfaces clean and smooth for safer flying. De-Icers were developed and are made exclusively by B. F. Goodrich. Years of ice-fighting experience are back of this equipment. It means a safer, more comfortable flight if you fly today or when you fly tomorrow. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

Service Begins at Factory

(*Continued from page 45*)

tributor seeking it. So no time is lost.

To encourage individual owners, operators, and dealers to order through their distributors, all orders received by the factory are forwarded to the proper distributor with a copy of the referral notice going to the person who placed the order and another copy being retained in the department files. And, to keep distributors fully informed, a copy of every letter going out from the service and parts department is sent to the distributor for the territory into which the letter is sent.

As a means of eliminating expense and red tape, the company provides distributors with printed purchase order forms applicable to any type of material which might be ordered from the factory. Use of these forms—which are furnished gratis—is encouraged, since their handling requires less clerical work.

In the third general category—related service and parts department functions—Field Service plays an important part. For example, the work of this department's representatives includes continuous collection of data on which the company's flat-rate repair manual is based and revised.

Another duty of the field service section is preparation and revision of service manuals. In addition, the company prepares two types of service bulletins—technical and general. The technical bulletins are prepared by the engineering department, but they are distributed by field service, which prepares as well as distributes the non-technical publications. Field service also handles stockroom layouts and stock bin planning for both service and parts department stockrooms and for distributors and dealers.

Since the service and parts department serves both customers and factory, it might seem to be in the position of having two masters. It is, however, considered as a most important link between the two, with its primary job that of giving the best possible service to its customers so that the factory can concentrate on its job of producing airplanes. With its functions divided into the three main categories described here, the department has been able to perform its duties with the efficiency and flexibility essential to success today.

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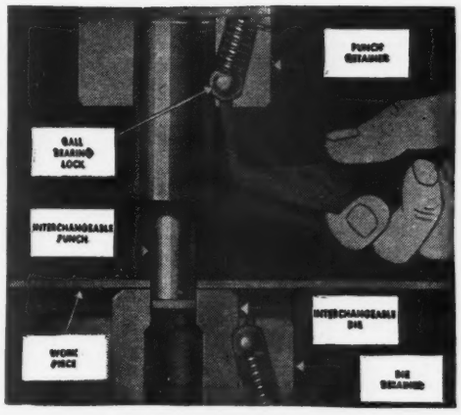

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Cut 100 pounds of dead weight per plane for a fleet of 10 airliners and you have saved $100,000 a year.

Where to cut this weight? There are many places . . . magnesium in doors, seats, oil tanks, wheels, engine accessories, will give the required strength and dependability, along with maximum savings.

American Magnesium engineers are old hands at weight saving. They will gladly help you employ magnesium to the best advantage in cutting off needless pounds. Call the nearest Alcoa sales office or write Aluminum Company of America, Sales Agent for American Magnesium Products, 1713 Gulf Building, Pittsburgh 19, Penna.

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The great developments in plane design and engineering have been equaled by improvements in communications and in electronics. Amphenol components for airborne radio and radar applications have been proven thoroughly dependable and efficient for every indicated use. Amphenol, while pioneering in new developments, also offers the most complete line of R.F. cables, connectors, plugs and plastic parts made by any one manufacturer. For dependable electronic components — mechanically perfect and electrically correct—look to Amphenol.

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—*yet the Red Elastic Collar protects permanently against* VIBRATION

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ESNA Elastic Stop Nuts are self-locking, easily removable, and reusable over and over. They protect permanently against Vibration, Corrosion, Thread Damage, Liquid Seepage and Costly Maintenance.

Here's a challenge: Send us complete details of your toughest bolted trouble spot. We'll supply test nuts—FREE, in experimental quantities. Or, if you want further information, write for literature.

Elastic Stop Nut Corporation of America, Union, New Jersey. Representatives and Agents are located in many principal cities.

The RED ELASTIC COLLAR

—denoting an ESNA product—

...is threadless and permanently elastic. Every bolt—*regardless of commercial tolerances*—impresses (does not cut) its full thread contact in the Red Elastic Collar to fully grip the bolt threads. In addition, this threading action properly seats the metal threads—and eliminates all axial play between bolt and nut threads.

All ESNA Elastic Stop Nuts—*regardless of size or type*—lock in position anywhere on a bolt or stud. Vibration, impact or stress reversal cannot disturb prestressed or positioned settings.

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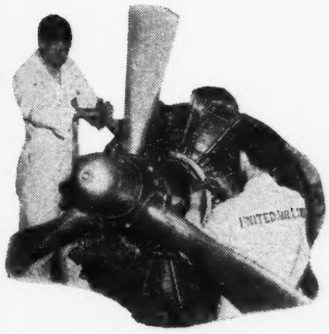
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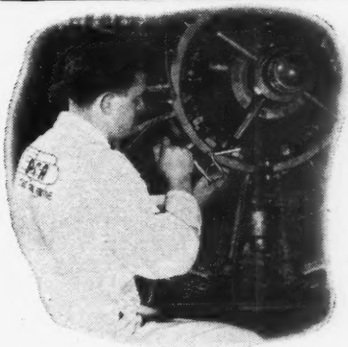
TRANS-CANADA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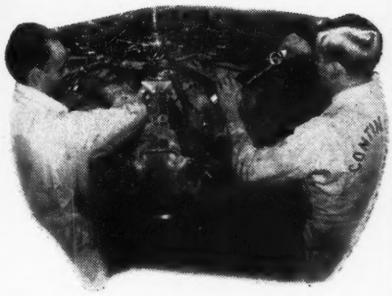
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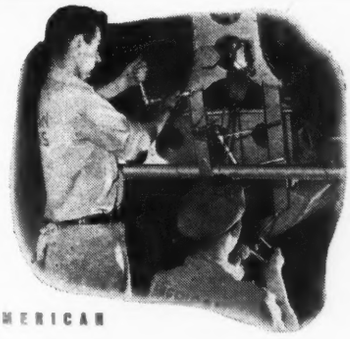
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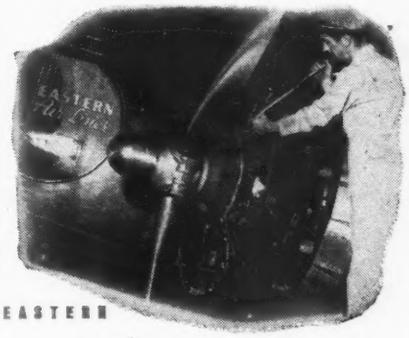
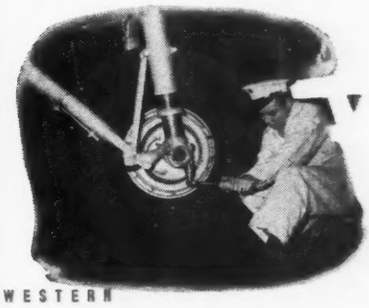

EASTERN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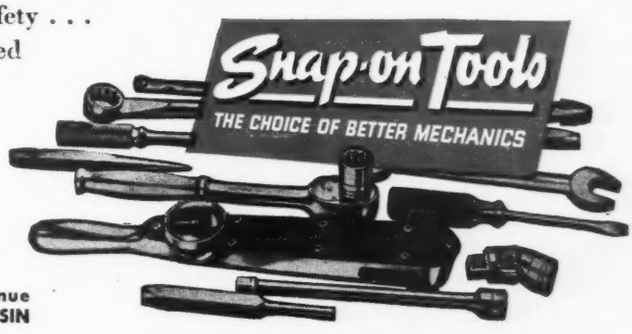
Matching the most rigid standards for speed, accuracy, safety . . . widely preferred by the maintenance executives and skilled mechanics who keep America's air fleets at peak efficiency . . . Snap-ons are everywhere recognized as the *tools of aviation.* Snap-on's direct-to-user service is conveniently available through 38 factory branch warehouses located in key aviation centers throughout the United States and Canada.



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SAY you are operating a transoceanic airline between New York and London. And say that suddenly you are permitted to carry 400 extra gallons of gasoline on top of your maximum load. Would that be a welcome stowaway on every flight?

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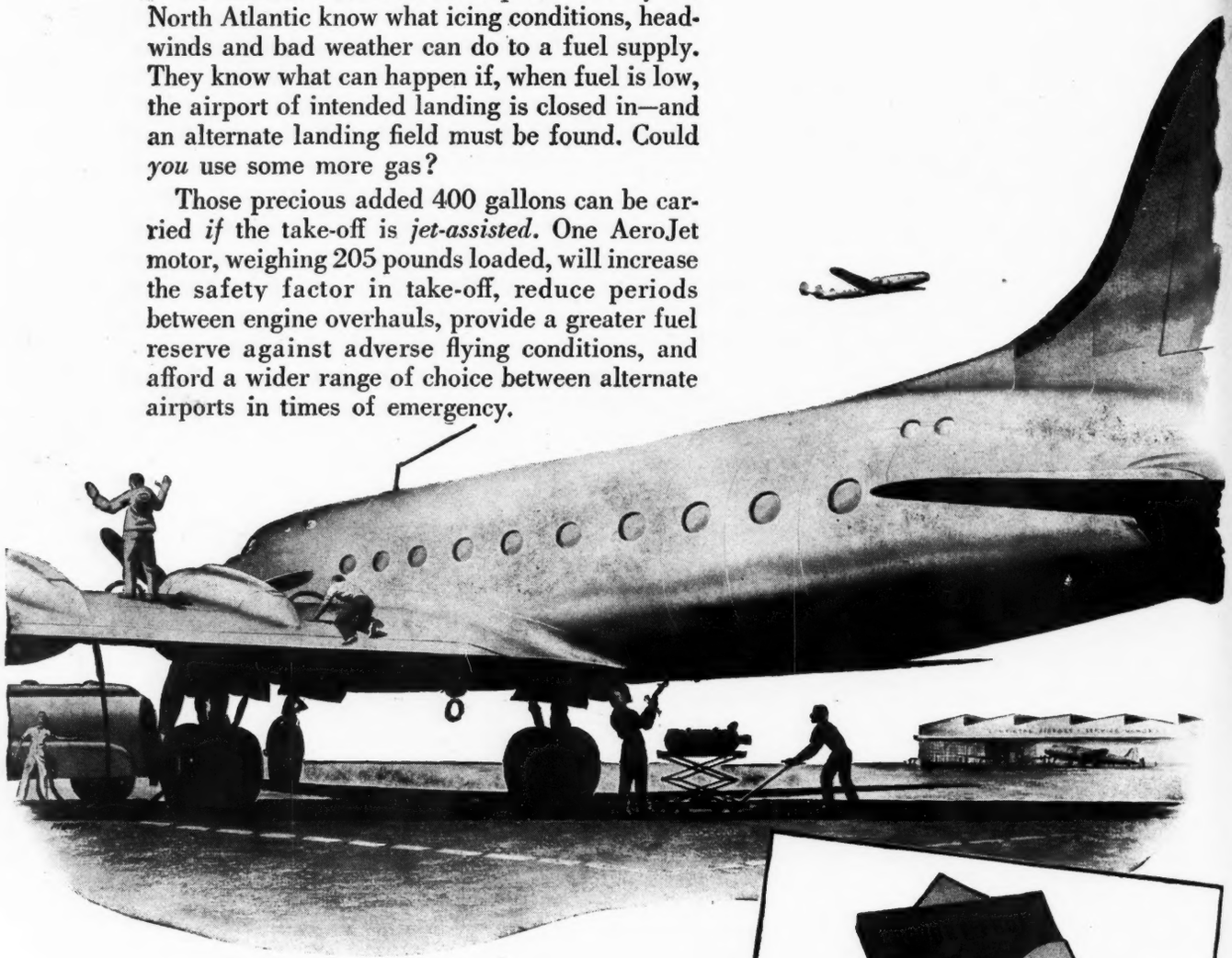
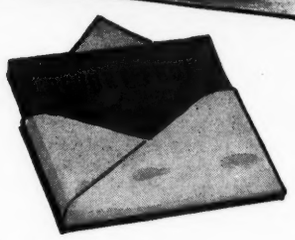


Airline operators and regulatory authorities are giving the advantages of AeroJet assistance their thoughtful consideration.



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Hansen Push-Tite Coupling is unique in that it is easy and fast to operate, just a slight push of plug into socket—it's connected, locked and air is automatically turned on. Slide sleeve back with thumb it is unlocked, disconnected and air is automatically shut off. There is no turning, adjusting or twisting of parts in order to connect, disconnect or to turn air on or off. It's all done by an easy push on plug to connect and a slight push on sleeve to disconnect. Complete swivel action prevents kinking of hose. Hansen Couplings will handle pressures from a few ounces to over 10,000 pounds without leaking.

Hansen Push-Tite air hose couplings are used for air, oil and grease. There are also other Hansen Couplings made to handle gasoline, acetylene and oxygen.

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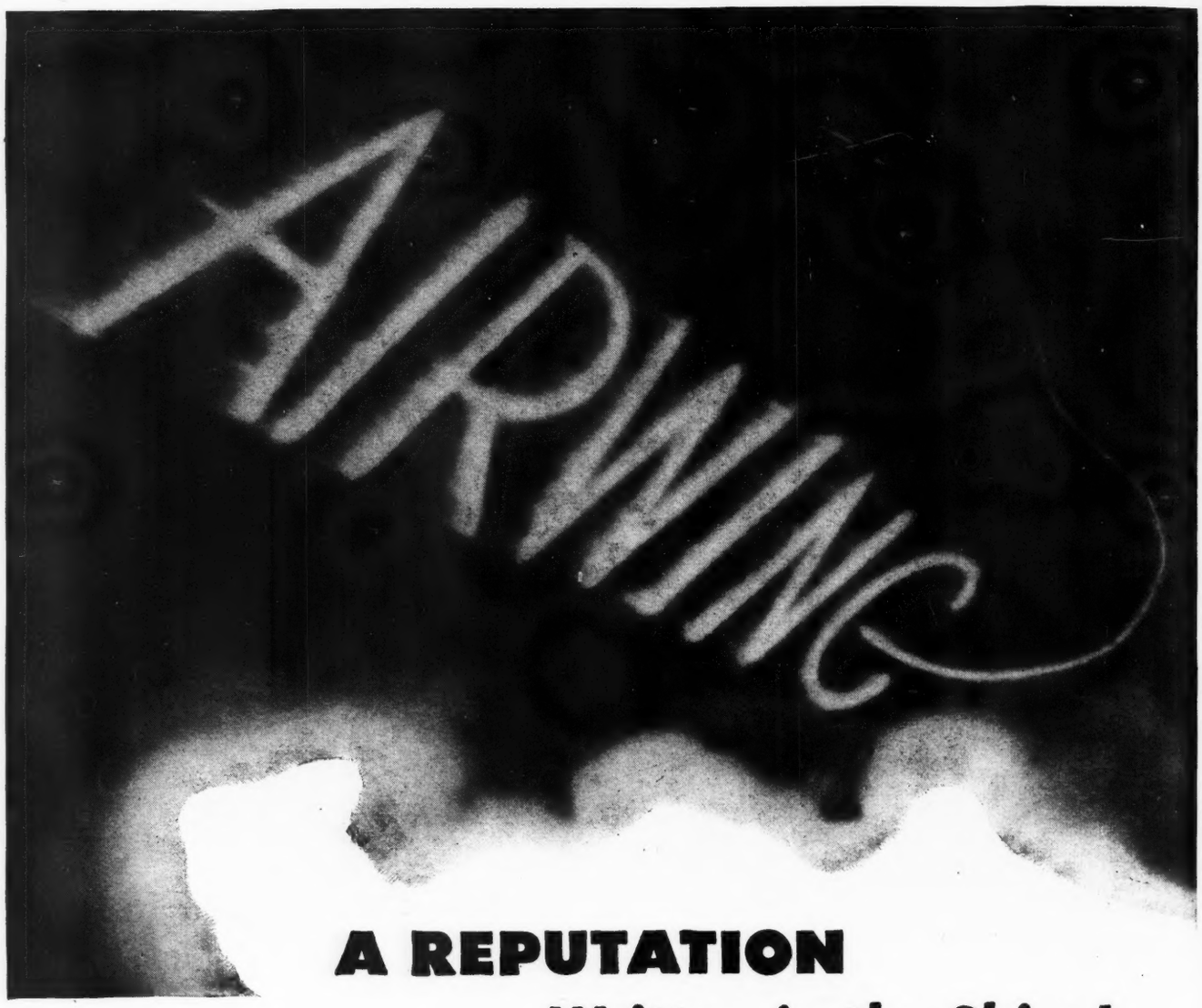

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The quality reputation of Airwing Fabrics and Tapes spans more than a quarter century of accomplishment in the field of textile manufacture for aircraft equipment. Having served with distinction through two World Wars where dependable, light weight fabrics of high tensile strength and easy applicability were demanded, Airwing is now ready to serve an air-minded world at peace.

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Nose Aerol of the XF-12

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Illustrated is the Republic XF-12. This giant photo-reconnaissance plane is the military forerunner of the Republic "Rainbow", a commercial transport expected to cruise at over 400 miles per hour at 40,000 feet, with a range of over 4,000 miles. • The XF-12, practically a flying photographic lab, is equipped with Cleveland Pneumatic AEROLS to protect plane, crew, and equipment during landings and takeoffs . . . Thus another plane joins the long list of outstanding aircraft which are Aerol-equipped.

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The Udylite Laboratories are common ground for scientific electrochemistry and practical electroplating practice. Here an organized program of research is continually discovering new techniques to improve electroplating processes and whittle down their costs—**That's Research**

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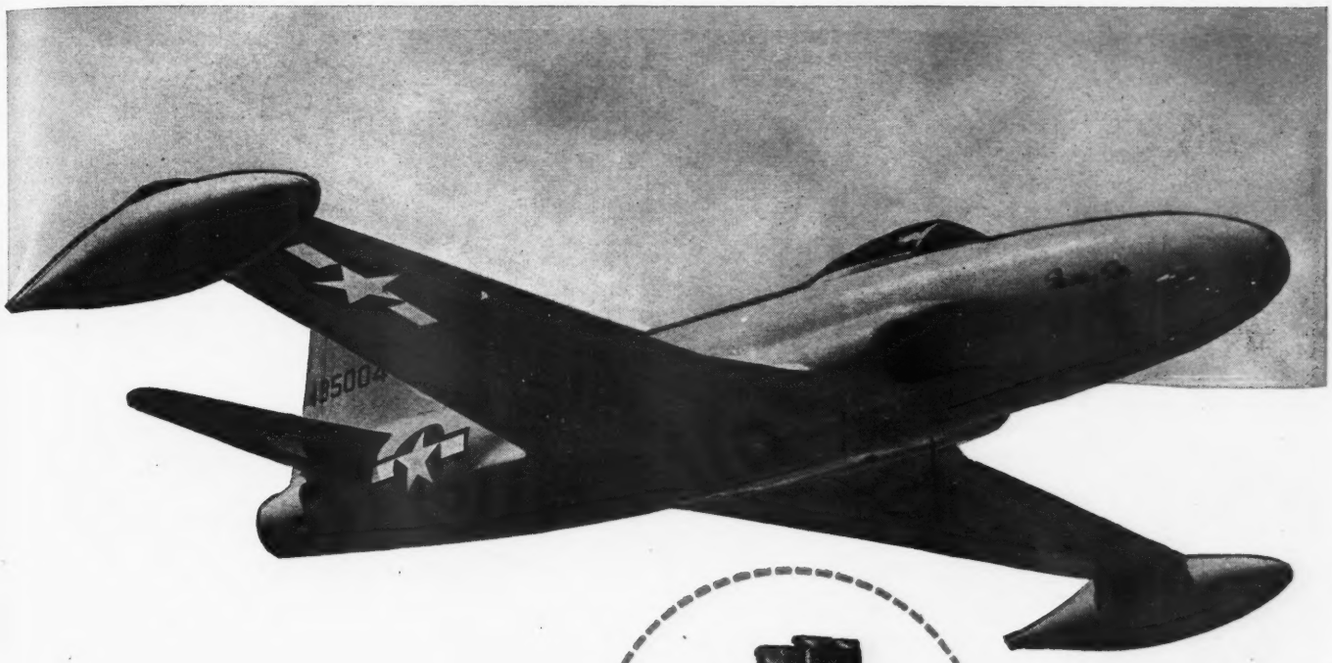

PIERCE GOVERNORS

The P-80 Shooting Star Made A Great Record
(COAST TO COAST- 4:13:26)

It Had A Great Engine
(TURBO-JET, I-40)

IT WAS CONTROLLED BY A GREAT GOVERNOR

● Shown here are the Lockheed P-80 Shooting Star —America's fastest production-line aircraft—and the Pierce-built hydraulic governor which gave it the amazingly close regulation it had to have. Together, this pair spanned the continent in a fraction over four hours.

The I-40 Turbo-Jet engine—operating at more than 10,000 RPM—produces 4200 pounds thrust —the equivalent of approximately 5000 horsepower at high speed. It has to be governed—with a degree of accuracy (figures restricted) that the governor world would have called completely impossible a short time ago.

But it *is* governed—*with that high degree of accuracy*—by an ultra-precision Pierce-built Hydraulic Governor. This is another high and proud accomplishment of The Pierce Governor Company, Inc., whose engineers have been meeting and solving all kinds of governing problems for 33 years—for one-third of history's most progressive century. Your engine-control problem is neither too big nor too small for our careful consideration.

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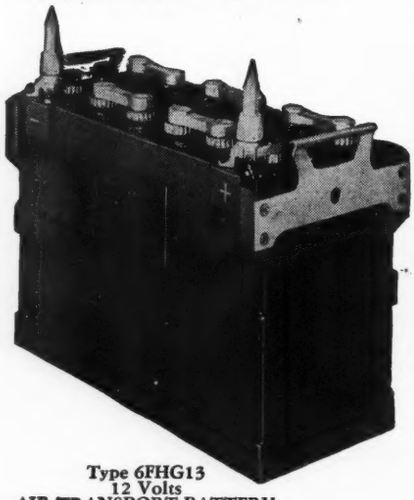

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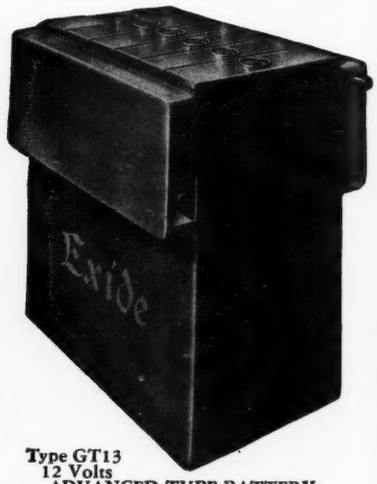


Type GT13
12 Volts
ADVANCED TYPE BATTERY
Used in jet propulsion

This is the thirty-third of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME

"Aviation has made our world a world of neighbors"

says V. E. CHENEA, Vice-President and General Traffic Manager, Pan American World Airways

"AS WE MOVE *into the Air Age the need for comity between nations as 'neighbors' becomes increasingly evident. Thanks to aviation, the world is now a close-knit 'neighborhood' with travel and trade (those twin builders of friendship) the bond between peoples.*

"The time is not far off when the things we've been content to hear about or read about will be ours to see and experience —when a two- or three-week vacation in a once-distant continent will be a commonplace—when the ease and comfort of travel in new, modern clippers will bring the world, and a better understanding of its peoples, within the range of men and women everywhere.

"For businessmen who realize the vital role that foreign trade will play in our prosperity, faster, luxurious planes will provide timesaving transportation to potential markets awaiting American enterprise and vision."

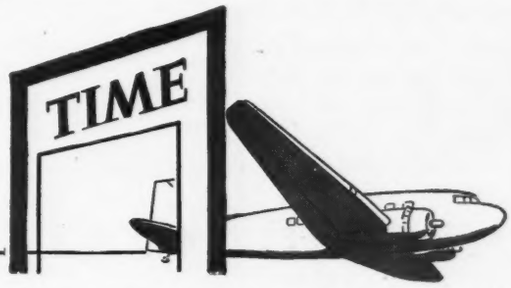
• • •

First to team up with the aviation industry, first to follow American enterprise along the skyways of the world will be the U.S. "test-pilot" market of air-minded people—Americans who have the habit of progress and the means to buy it—men and women like the 3,000,000 readers of TIME.

TIME subscribers report they have traveled 3,048,000,000 airline miles. More than 36,000 TIME subscribers have already owned and flown their own planes—and 500,000 more say they hope to.

Wherever Americans fly, TIME flies too. Look around you the next time you travel by air and count the number of your fellow passengers who carry TIME or ask the stewardess for a copy. Group after group of air-minded people—airline travel card holders, leading executives in business and government, engineers, professional men—vote TIME their favorite magazine by margins of up to 7 to 1 over any other.

TIME to sell Aviation



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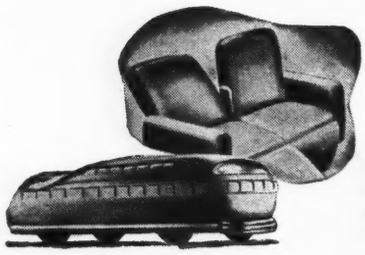
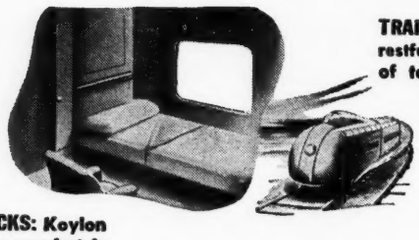
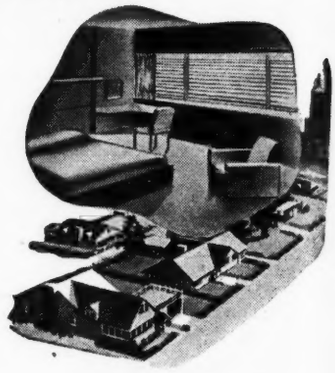


BUSES & TRUCKS: Koylon clean, durable comfort is perfect for tomorrow's heavy duty business.



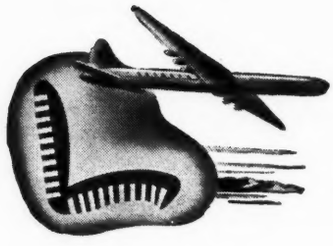
TRAINS: Koylon all-condition restfulness is ideal for the cars of tomorrow's streamliners.



INTERIORS: Koylon adaptability is especially suited for upholsterers and designers of tomorrow's interiors.

SERVING THROUGH SCIENCE

Lightness and comfort that belong in planes



PLANES: Koylon lightness fits plans for tomorrow's plane interiors.

WHEN A PRODUCT ushers in a wonderful new era of comfort, it belongs in all your plans. Well, that's what Koylon did.

For eleven years, Koylon has proved itself the comfort cushioning of the age. It breathes comfort — the kind that will be appreciated by the user — the kind that means increased good will for you.

At every contact with the body, thousands of tiny Koylon latex cells release air. That's the famous Koylon breathing action — the secret of Koylon's comfort. It's also the secret of Koylon's resilience and natural cleanliness — dust-free, moisture-free, vermin-free.

Light, long-lasting, a single unit free of bothersome parts to wear out and lose shape — Koylon is both simple and amazingly inexpensive to maintain. It has proved its value in the past — and it belongs in the future. Particularly, Koylon belongs in your future plans.

Comfort Engineered

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WEIGHT. . . . . .19 OZ.
ROTATION. . . . . C'CLOCK. DRIVE END
CONTINUOUS DUTY
EXPLOSION RESISTANT
CONNECTOR. AN-3102-10S-2P
PESCO

Electric motors by *PESCO* are here . . . electric motors specifically designed to meet the requirements of the aircraft industry!

These new *PESCO* electric motors are the result of years of study of the problems and needs of aviation. For the past three years the knowledge gained from these studies has been put to practical, intensive use . . . in exhaustive engineering development and design work . . . in thorough research . . . in extensive field tests . . . to perfect an electric motor for aircraft use.

The result is a new electric motor that is a fitting complement to the hydraulic, fuel and vacuum accessories which have made the name *PESCO* synonymous with quality in the field of aviation.

PESCO electric motors are built in *six co-ordinated frame sizes*. With this unified series of frames, motors covering a wide range of speeds and horsepower ratings can be built combining the advantages of custom design with standardized parts. The motor is lightweight, compact and efficient.

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Gentlemen:

I know you will be interested in the service which we have been obtaining from your RB-19-R spark plugs.

The spark plugs which we formerly used had to be removed for overhaul, including both re-gapping and sandblasting, every 135 hours. Because of the lower erosion characteristics of the electrodes in your plugs, we have been able to operate them 270 hours between overhauls, and the overhaul consists simply of re-gapping -- the sandblasting is unnecessary. Your B. G. plugs operate a full 1000 hours before a complete overhaul is needed.

You can appreciate how the improved service we are obtaining from your spark plugs has resulted in a reduction in our maintenance costs and why we are thoroughly satisfied with them.

Very truly yours,

S. R. Shatto

Stanley R. Shatto
Vice-President in charge of Maintenance and Engineering

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The airlines themselves provide the gauge of the quality of BG Spark Plugs. For over a quarter of a century, BG plugs have been standard equipment on major airlines—they have proved themselves by *service*. Both mica-insulated and ceramic-insulated BG spark plugs are designed and built to the highest possible standards for economy, dependability and long life.

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136 West 52nd St., New York 19, N. Y.
Manufacturers of both ceramic-insulated and mica-insulated aviation spark plugs. Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders.

the more they'll need *Equi-Tract**

As wing spans grow wider and distances from nose to tail increase, the need for control cables that are *not* subject to slackness at high altitudes, becomes more and more imperative. This requirement has been met by the development of U·S·S American ***Equi-Tract*** Control Cable.

For here is a steel cable in which the contraction and expansion differential between the airframe and the cable has been reduced by approximately 80%.

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U·S·S American ***Equi-Tract*** Control Cable has been put through its paces, and enthusiastically accepted, by leading American aircraft builders. Our engineers will gladly discuss its application to vour designs.

*The steel control cable that retains control sensitivity at high altitudes.

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No ship too big...
and none too small...for PITTSBURGH
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FOR DEPENDABLE, long-lasting protection there's no better aircraft finish than Pittsburgh!

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In addition to a complete line of aircraft coatings, Pittsburgh offers a wide variety of industrial finishes for every purpose. Call on us for advisory service—our experience can often save you time and money!

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PITTSBURGH *Industrial* FINISHES

PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS

DRAFTSMAN: Thanks. It's nice to be back. But just what do you mean by 'one Winner to another'?

NILMERG: A figure of speech — a happy alliteration. You — the WINNER in War and A. W. Faber's The WINNER Thin Lead Colored Pencil.

DRAFTSMAN: Ah, A. W. Faber — it's good to hear that name again. Brief me on The WINNER.

NILMERG: Just picture a thin lead colored pencil that swishes over your drawing with brilliant, eye-dazzling impressions. A colored pencil so strong that you can sharpen it to a needlepoint without snapping . . .

DRAFTSMAN: Does The WINNER have a nice range of colors?

NILMERG: That it does — Red, Blue, Green, Black, White, Brown, Carmine, Blueprint Yellow and Blueprint Orange. But wait a moment — The WINNER has another feature that you can *really* get excited about.

DRAFTSMAN: I'm all ears.

NILMERG: The WINNER lead is practically insoluble in the perspiration of your hands. That means no more finger marks, no more smudges on your drawings.

DRAFTSMAN: That does it! All during the War I promised myself that I would never again endure anything cheap or inferior in civilian life. Where do I buy The WINNER?

NILMERG: From your own Dealer. If he doesn't happen to have 'em, write to A. W. Faber, Inc., Newark 4, N. J.

A.W. FABER INC. NEWARK, N.J.

The WINNER *thin lead* COLORED PENCILS

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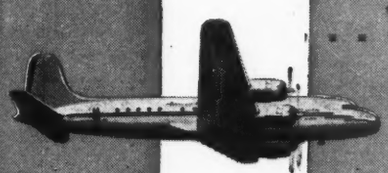
. . . for its new fleet of Douglas DC-6 Transports



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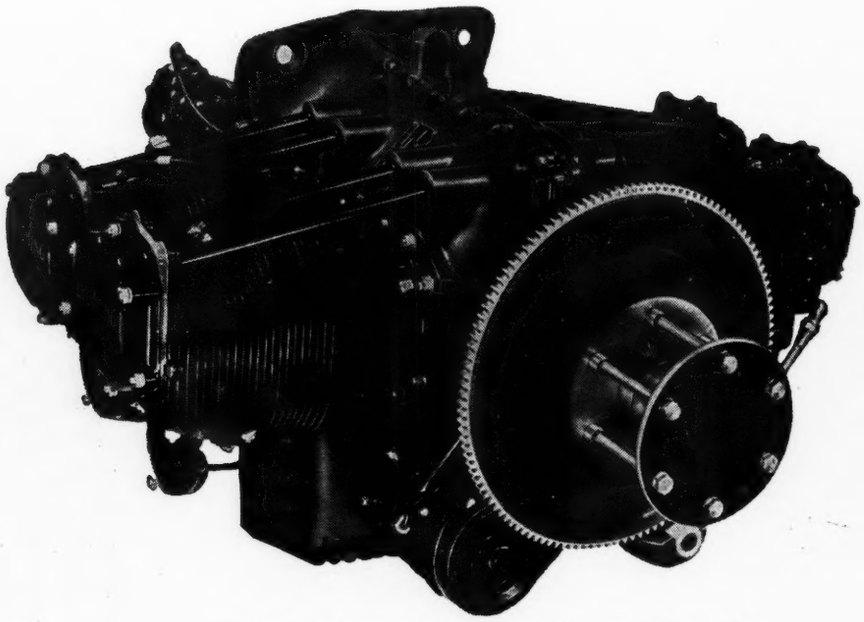
a combination that's *"Plane Perfect"*

New Piper Cub Super Cruiser powered by the new 100 H.P. LYCOMING



Inherently smooth—economical—reliable—the O-235-C is a dependable engine for a dependable plane

For safe, sure flying, insist that your plane is "powered by Lycoming."

Reliability! Before any Lycoming earns its wings, it must pass 3200 rigid inspections, undergo all known laboratory tests and then be test run, re-examined and test run again for hours. You know you can rely on a Lycoming.

LYCOMING

AN Avco PRODUCT **AIRCRAFT ENGINES**

Lycoming Division, Dept. B-1
The Aviation Corporation
Williamsport, Pa.

Write today for free booklet on the O-235-C Engine.

Name_____

Address_____

SAVE TIME
with
MORRISON Metal Stitching

VITAL ASSEMBLY HOURS can be saved through Morrison Metal Stitching. This is a fact proved by results obtained in many of the country's aircraft plants already equipped with Morrison Metal Stitchers.

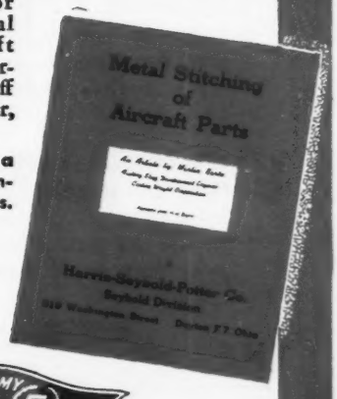
At Curtiss-Wright, for example, the first five jobs converted to the metal stitching process required a total of 67 man-hours as against the 497 man-hours formerly required for riveting. Consolidated Vultee Aircraft Corporation found that Morrison Metal Stitching decreases assembly time by as much as 70% *on many parts.*

NOW these stitchers are available to *all* industries for assembly of steel, aluminum, stainless steel, woods, fabrics, rubber, plastics or other composition materials. The following fabricators of aircraft parts, plus many others, have proved Morrison's time-saving ability:

A.C. Spark Plug Division of General Motors Corp.
Air Technical Service Command
Beech Aircraft Corp.
Bell Aircraft Corp.
Boeing Aircraft Company
Briggs Manufacturing Company
Chance Vought Aircraft Division of General Motors Corp.
Chrysler Corporation
Consolidated Vultee Aircraft Corp.
Curtiss-Wright Corporation
Delco Remy Division of General Motors Corp.
Douglas Aircraft Company, Inc.
Fisher Body Division of General Motors Corp.
Ford Motor Co.
General Fire Proofing Co.
General Motors Corp.
Goodyear Aircraft Corp.
Grumman Aircraft Engineering Corp.
Gulberson Corp.
Higgins Aircraft, Inc.
Hoover Co., Inc.
Lockheed Aircraft Corp.
Glenn L. Martin Co.
National Gypsum Co., Inc.
North American Aviation, Inc.
Northrup Aircraft, Inc.
Packard Electric Division of General Motors Corp.
Republic Aviation Corp.
Rohr Aircraft Corp.
U. S. Engineers
Willys-Overland Motors, Inc.

Write Dept. A-4 for booklet entitled Metal Stitching of Aircraft Parts, an article by Martin Barbe, Factory Staff Development Engineer, Curtiss-Wright Corp.

We also manufacture a complete line of book, container and steel stitchers.

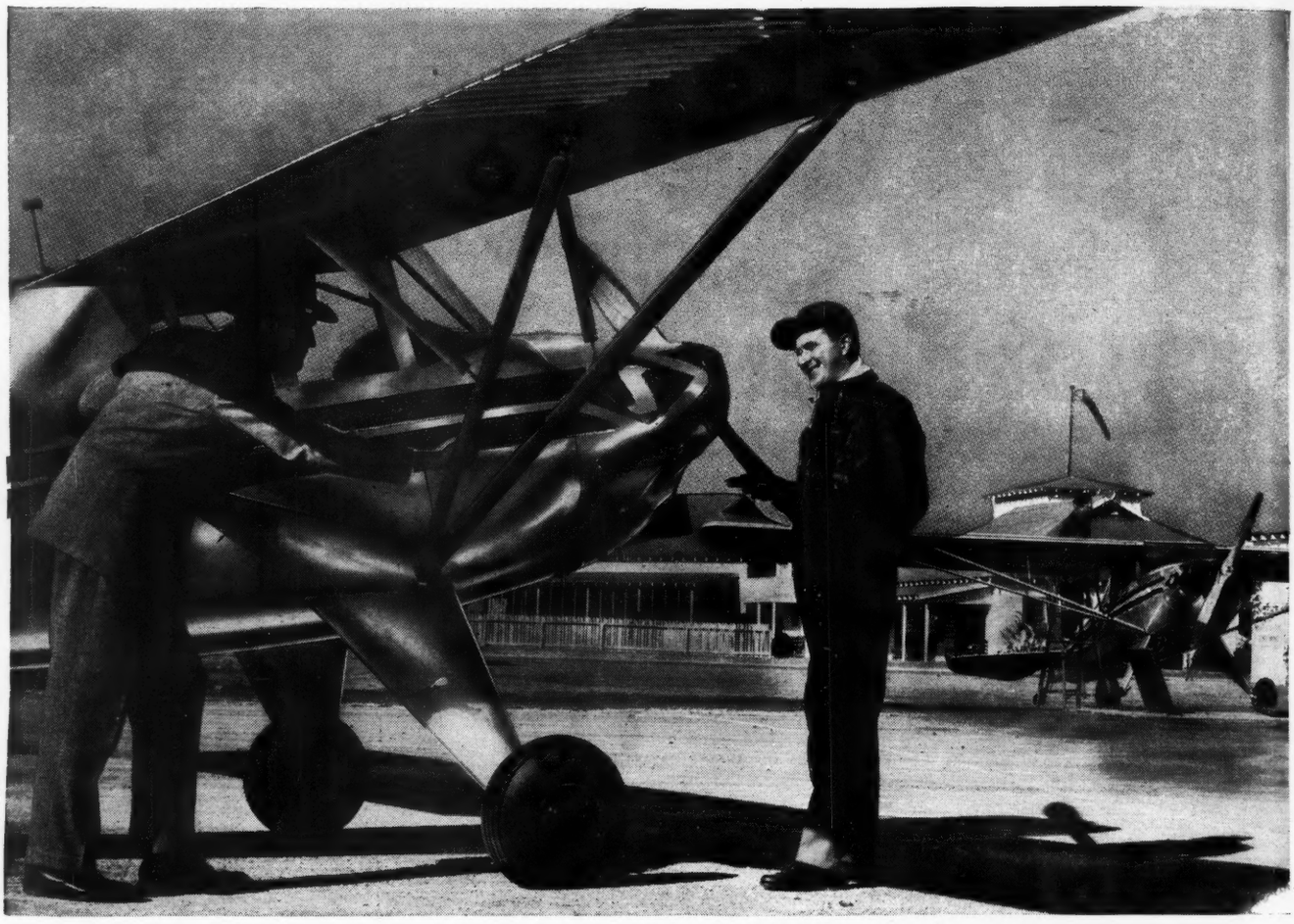


ARMY E NAVY

Sales and service representatives in all principal cities.

MORRISON STITCHERS

PRODUCTS OF THE SEYBOLD DIVISION
HARRIS-SEYBOLD-POTTER COMPANY
DAYTON F8, OHIO



Ask the pilot who flies Silvaire *and he'll tell you...*

1 *Silvaire* the *original* all-metal personal plane is *tried, tested* and *proved.* Made to meet the most exacting standards of craftsmanship, the Silvaire is backed by more than 12 years of personal aircraft production experience.

2 *Silvaire* is easy to fly. It responds instantly to finger-tip control. Smooth, effortless performance combined with roomy, deeply upholstered seats, makes cross-country flying a restful pleasure.

3 *Silvaire* is *safe.* Just as the turret top of today's automobile adds to its safety, the rugged, extra strength of the exclusive *safety-zone* cabin in the Silvaire is your assurance of maximum protection at all times.

4 *Silvaire* gives higher airspeed per horsepower. Slow, safe landing speed lets you 3-point it into the smallest airfields. Ample capacity fuel tank gives longer range.

5 *Silvaire* in gleaming metal, with its attractively designed and finished interior and instrument panel, gives you luxury liner appointments in your personal plane.

6 *Silvaire* with its smooth, streamlined low-drag contour and high efficiency wing, operates at a cost per ground mile comparable to a medium priced automobile.

THE *Silvaire*

BY LUSCOMBE

first in ALL-METAL personal planes

LUSCOMBE AIRPLANE CORPORATION • *Dallas, Texas*

For business, for sport, for pleasure, for family flying—the Silvaire is the plane of the day. And remember—if you can drive a car, you can fly a Silvaire. See your dealer today.

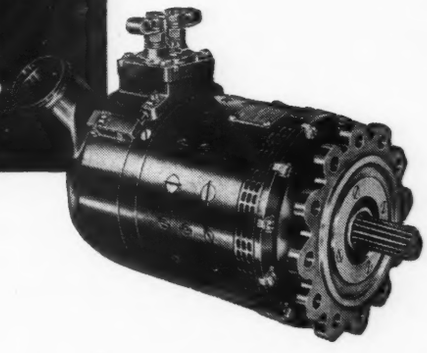
IN 1920—
11.3 WATTS PER LB.

In 1920 Leece-Neville made news with this generator for Army planes. 35 amperes, 15 volts, diameter 6 inches, length 13½ inches, weight 46¼ pounds.

Leece-Neville

AIRCRAFT ELECTRICAL EQUIPMENT

IN 1946—
88.5 WATTS PER LB.



Popular in wartime aviation—and now, in peace . . . Type O-1 Leece-Neville generator. 100 amperes, 28.5 volts, diameter 6 inches, length 12 7/16 inches, weight 32¼ pounds.

LEECE-NEVILLE

Pioneer and STILL Quality Leader

GENERATORS • VOLTAGE REGULATORS • SWITCH RELAYS • PUMP MOTORS

GOODALL MAINTAINS LEADERSHIP WITH *Blended-for-Performance* FABRICS

Development of new design and fabric on pilot loom

A RECOGNIZED pioneer in blending, Goodall has been a leader in presenting to consumers and industries the advantages which can only be achieved by blending different fibers and yarns. Today yarn and textile authorities agree that no one fiber can produce the best fabrics for all purposes—and in every division of the textile industry, technicians are attempting to achieve perfection by blending. To maintain leadership in blending, Goodall stylists and technicians are constantly designing, experimenting and testing to create new and better BLENDED-FOR-PERFORMANCE fabrics.

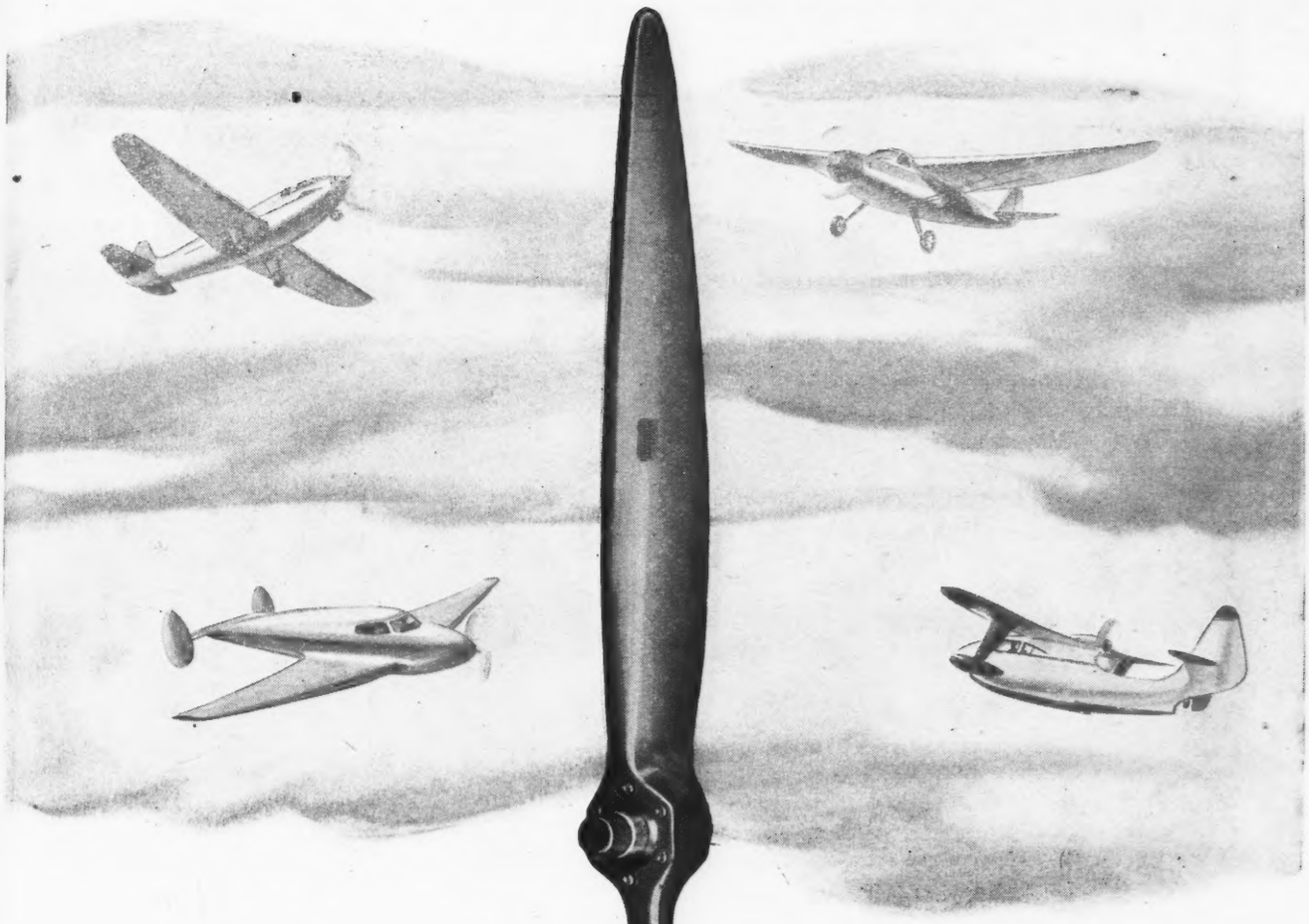
Goodall Fabrics INC.

Subsidiary of Goodall-Sanford, Inc.

THE FINEST NAME IN FABRICS

Offices in Boston, New York, Detroit, Chicago, Los Angeles

Mills at Sanford, Maine, and Reading, Massachusetts



Now . . . . for aluminum propellers personal planes

For that personal plane you're building . . . have you considered this new propeller made of Alcoa Aluminum by the McCauley Corporation, Dayton, Ohio? You'll find it well worth your while.

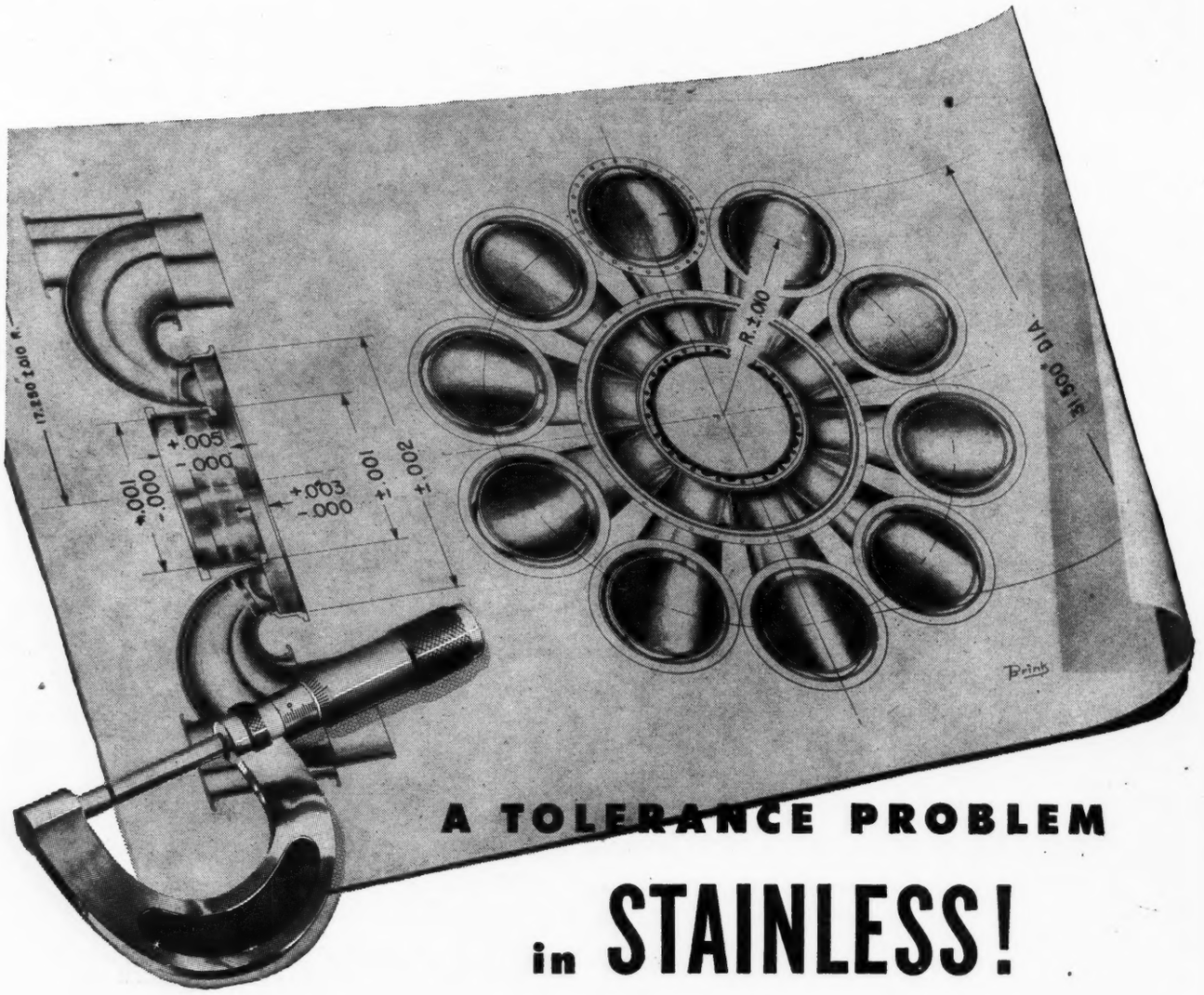
Here you have a light, thin-section, corrosion-resistant, durable propeller. You'll get greater efficiency—shorter take-off runs, increased rate of climb and faster cruising speed. You'll be able to offer a personal plane with higher performance ratings.

At war's end, over eighty per cent of the blades used were aluminum. The same experience in making forgings for those blades is now going into Alcoa Aluminum forgings for personal plane propellers.

ALUMINUM COMPANY OF AMERICA, 2182 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM



A TOLERANCE PROBLEM in STAINLESS!

JET ENGINES ARE HARD TO MAKE

Specifications called for this stainless sheet metal elbow assembly. Notice the indicated tolerances! A tough job in any sheet metal—a terrific undertaking in stainless steel!

BUT SOLAR TACKLES ANY STAINLESS JOB

Utilizing the exclusive SOL-A-DIE process of forming and Solar's own specially developed welding, fitting and processing techniques, Solar's engineers and craftsmen maintained these exacting tolerances under successive production contracts.

SO IF YOU HAVE A TOUGH PROBLEM . . .

which involves combating corrosion or heat—consider stainless steel. Put it up to SOLAR engineering and production skill. Our nearest office is ready *right now* to help you tailor stainless steel to your special needs.

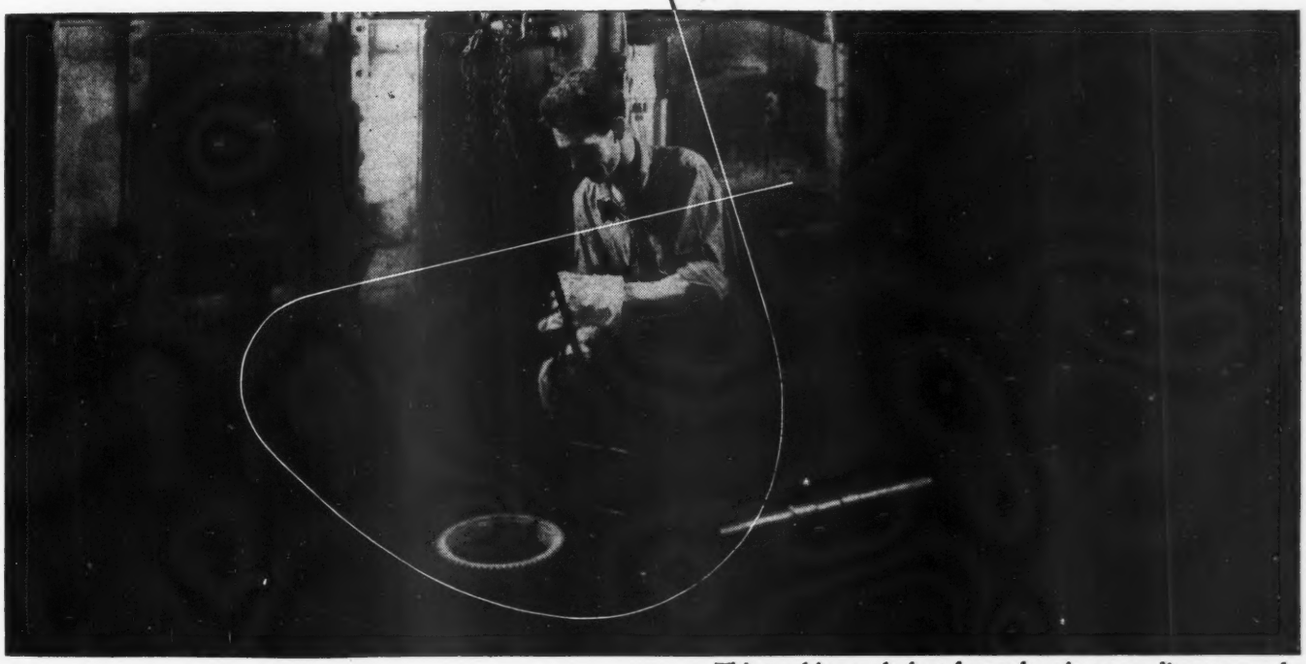
SOLAR
AIRCRAFT COMPANY

SAN DIEGO 12, CALIFORNIA : DES MOINES 6, IOWA : 60 E. 42ND STREET, NEW YORK 17, N. Y.

"with GULF SUPER-QUENCH

we get greater hardness and lower cleaning costs"—

says the Chief Metallurgist of this Plant



This machine tool plant formerly using an ordinary quenching oil had considerable difficulty in obtaining a satisfactory hardness on their gears. With Gulf Super-Quench the average hardness obtained increased 6 points Rockwell.

"WHEN WE USED a conventional quenching oil, we had difficulty in getting the minimum hardness specified for our gears," says the Chief Metallurgist of this machine tool plant. "With Gulf Super-Quench we consistently average three Rockwell C points above the required hardness. This remarkable quenching oil has also made possible a big reduction in cleaning time, thus reducing our cleaning costs."

Here's why Gulf Super-Quench is a superior quenching oil: It has intensified dual-action—a faster cooling rate through the hardening temperature range. Call in a Gulf Service Engineer today and let him show you how Gulf Super-Quench can help improve your quenching practice. For your copy of the brochure on Gulf Super-Quench, send the coupon below.

Gulf Oil Corporation • Gulf Refining Company

Division Sales Offices:

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GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company A
3800 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of the brochure, "Gulf Super-Quench."

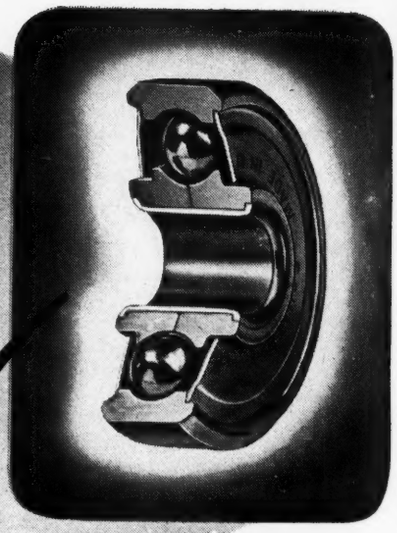
Name.....

Title.....

Company.....

Address.....

Compare Them with SCHATZ ✓



STEEL ✓

HEAT-TREATING ✓

ACCURACY ✓

PLATING ✓

TOLERANCES ✓

TESTING ✓

Schatz ball bearings are made of the finest steels available for the purpose . . . scientifically heat-treated for extra hardness and strength.

Schatz ball bearings are accurate . . . with closest tolerances faithfully observed.

Plating is carefully done to avoid "freezing" and entirely removed from raceways.

3-point contact design is another valuable feature which permits even distribution of the load.

And finally . . .

Component parts of Schatz ball bearings are subjected to "crushing tests" and any ball, or ring that shows weakness, is immediately rejected.

Check the control bearings you use and see if they measure up to the Schatz standards of strength, accuracy and reliability.

THE SCHATZ MANUFACTURING COMPANY

POUGHKEEPSIE, N. Y.

REPRESENTATIVES LOCATED AT

Detroit: 2640 Book Tower–26 • Cleveland: 402 Swetland Building–15

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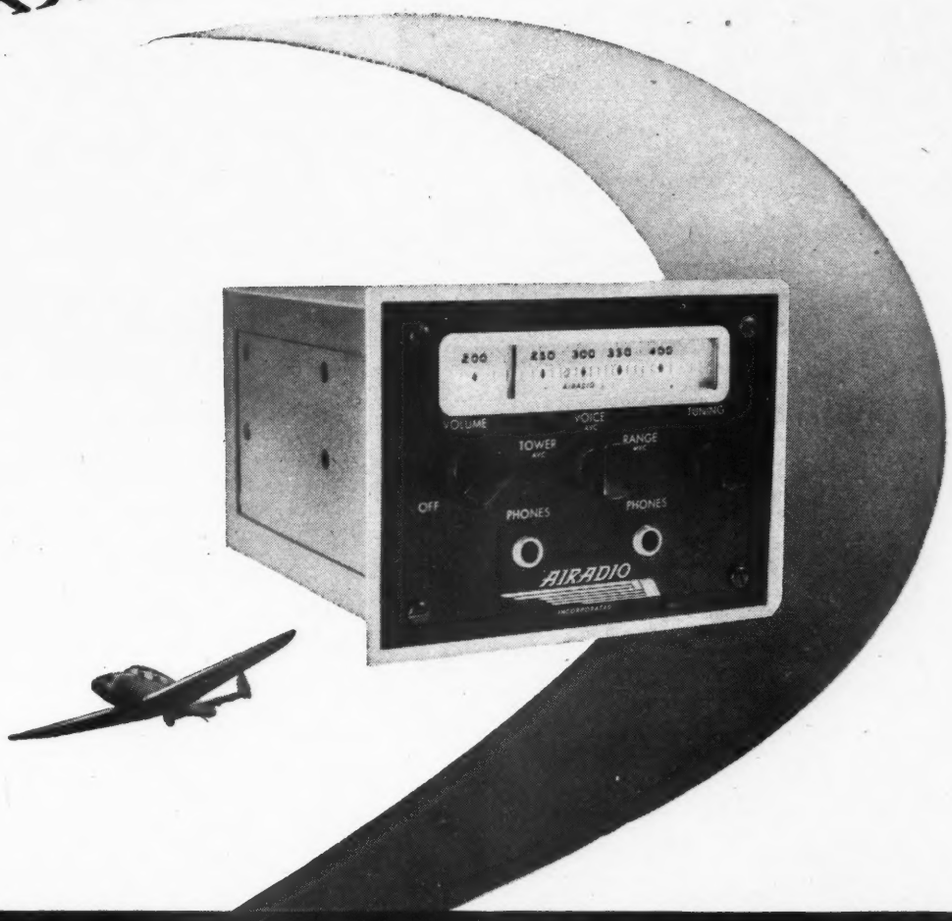
AIRADIO presents . . .



the SUPER "41" aircraft receiver

A MARVEL OF RADIO EFFICIENCY... COMBINING POWER AND SENSITIVITY WITH COMPACTNESS AND LIGHT WEIGHT... IN A BATTERY OPERATED UNIT TIPPING THE SCALES AT ONLY 2 POUNDS 13 OUNCES.

1. Unequalled for clarity and dependability of long-range reception, the **SUPER "41"** ends forever the faint and fading signals of ordinary battery receivers.

2. Easy to install and simple to operate, the **SUPER "41"** becomes as convenient and useful in your plane as the "throttle."

3. The **SUPER "41"** will give you far longer and more dependable service. Its *standard size* components are replaceable anytime... anywhere!

4. Install the *AIRADIO* **SUPER "41"** in your plane and know that your radio troubles are ended forever.

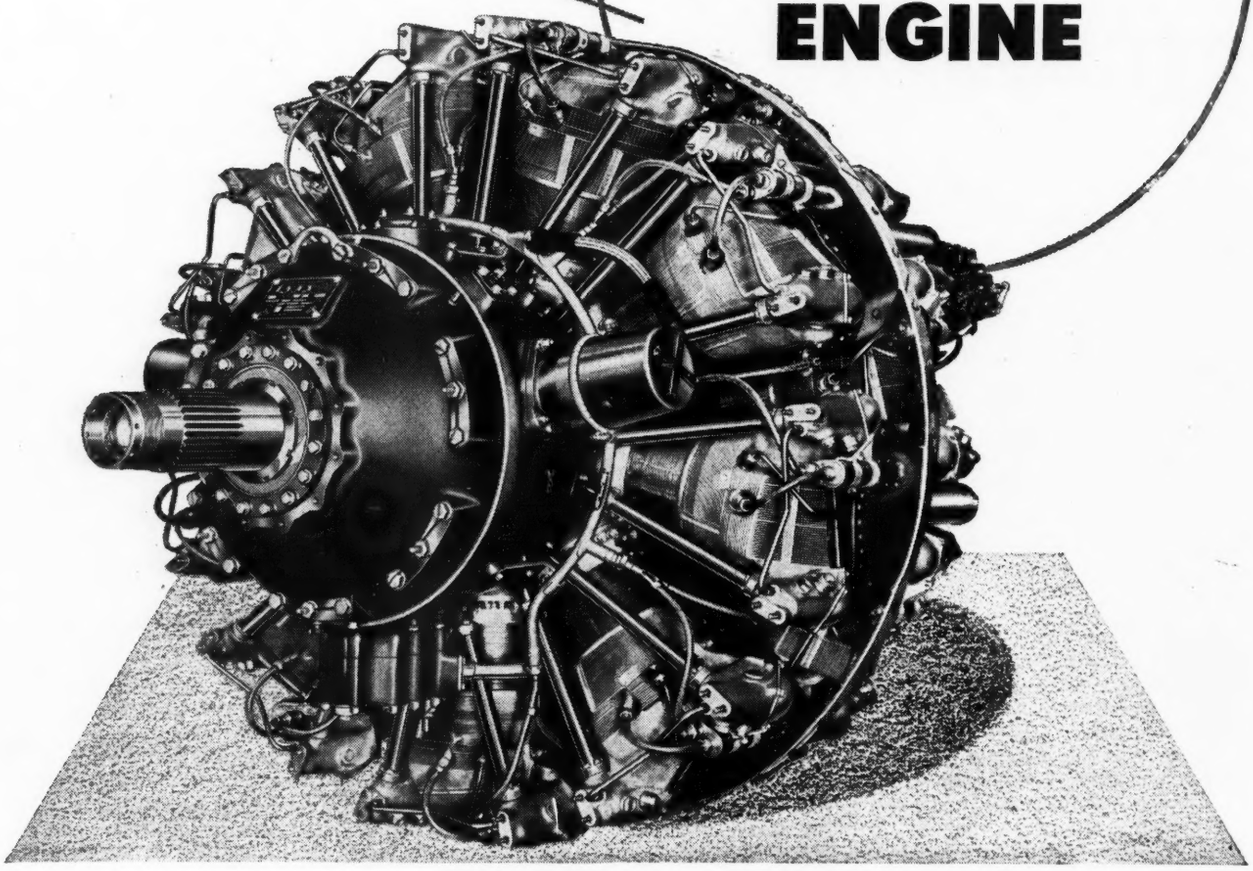
Write today for particulars about the "World's Most Modern Aircraft Radio."

AIRADIO
INCORPORATED · STAMFORD, CONNECTICUT
PRODUCTS OF RESEARCH . . . SKILL . . . EXPERIENCE

DISTRIBUTED BY AIR ASSOCIATES, INC., TETERBORO, N. J.
Branches: ATLANTA • CHICAGO • DALLAS • KANSAS CITY • LOS ANGELES

Scintilla "sparks" the finest

THE
WRIGHT CYCLONE 18 BD ENGINE



This most recent addition to the family of famous Wright engines—the 18 cylinder 2500 HP CYCLONE—uses the BENDIX SCINTILLA LOW TENSION AIRCRAFT IGNITION SYSTEM

BENDIX SCINTILLA

SCINTILLA* MAGNETO

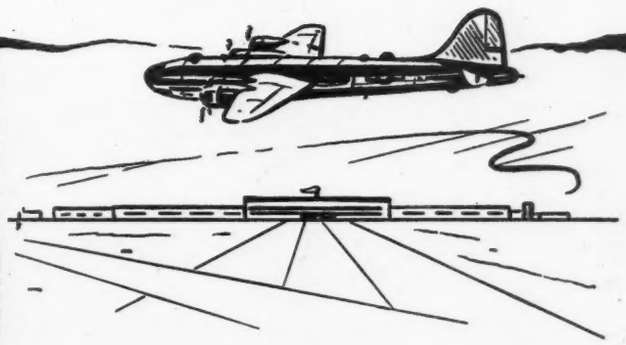
DIVISION OF BENDIX AVIATION CORPORATION
SIDNEY • • • NEW YORK

*TRADE MARK

PRODUCT OF Bendix AVIATION CORPORATION

THE LAST IN A SERIES OF "SCINTILLA SPARKS THE FINEST" ADVERTISEMENTS

IT'S A RECORD!



Aviation records make news these days at the rate of about one a week. In just two months, these eight new speed-distance marks were logged:

Guam to Washington, Army "Dreamboat," November 20, 1945 . . . Hartford to Seattle, Army "Dreamboat," December 8, 1945 . . . Paris to Washington, T.W.A. "Paris Sky Chief," December 9, 1945 . . . Seattle to Burbank, Army "Dreamboat," December 11, 1945 . . . Burbank to New York, Army "Dreamboat," December 11, 1945 . . . New York to Bermuda, Pan-American, January 14, 1946 . . . Bermuda to New York, Pan-American, January 15, 1946 . . . New York to Portugal, Pan-American, January 20, 1946.

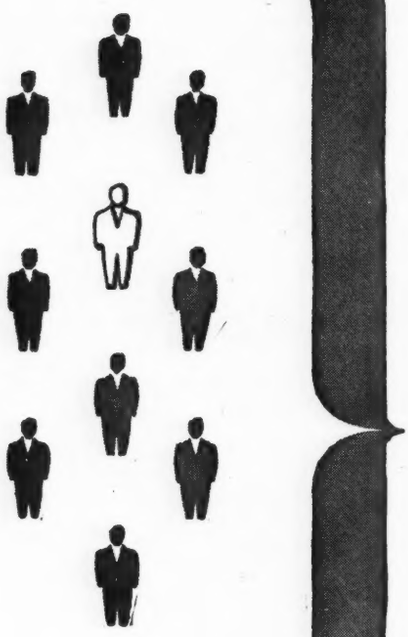
CECO Carburetors were on the planes which set all of those records. Was that a coincidence? We'll leave the answer to you, as we pledge continued research and development toward the records of tomorrow — and tomorrow.

CARBURETORS
FUEL PUMPS
PROTEK-PLUGS

CHANDLER-EVANS CORPORATION

WEST HARTFORD 1, CONNECTICUT, U. S. A.

CECO



9 OUT OF 10 *want* THE PAYROLL SAVINGS PLAN CONTINUED!

Thanks to the cooperation and encouragement of America's industrial executives, 85 million bond holders have bought U.S. Bonds in the greatest savings program in history. Employees who have purchased billions of dollars of these bonds during the war now want to continue monthly purchases of savings bonds. Specific evidence of this desire to continue saving for personal security and prosperity through the Payroll Savings Plan was recently revealed by a survey which disclosed that 90% wanted the Plan continued.

Every employer can write in his own set of reasons why the Payroll Savings Plan should be continued as a part of his personnel relations program, but the principal advantages are obvious:

A large reservoir of national savings; a strong and stable bulwark against inflation.

An "automatic" thrift habit for the worker; to increase contentment and satisfaction in his job.

An opportunity for the employee to maintain his "share in America" with the safest, easiest, most profitable investment he can make.

An opportunity for the returned veteran to share in the Payroll Plan's varied benefits.

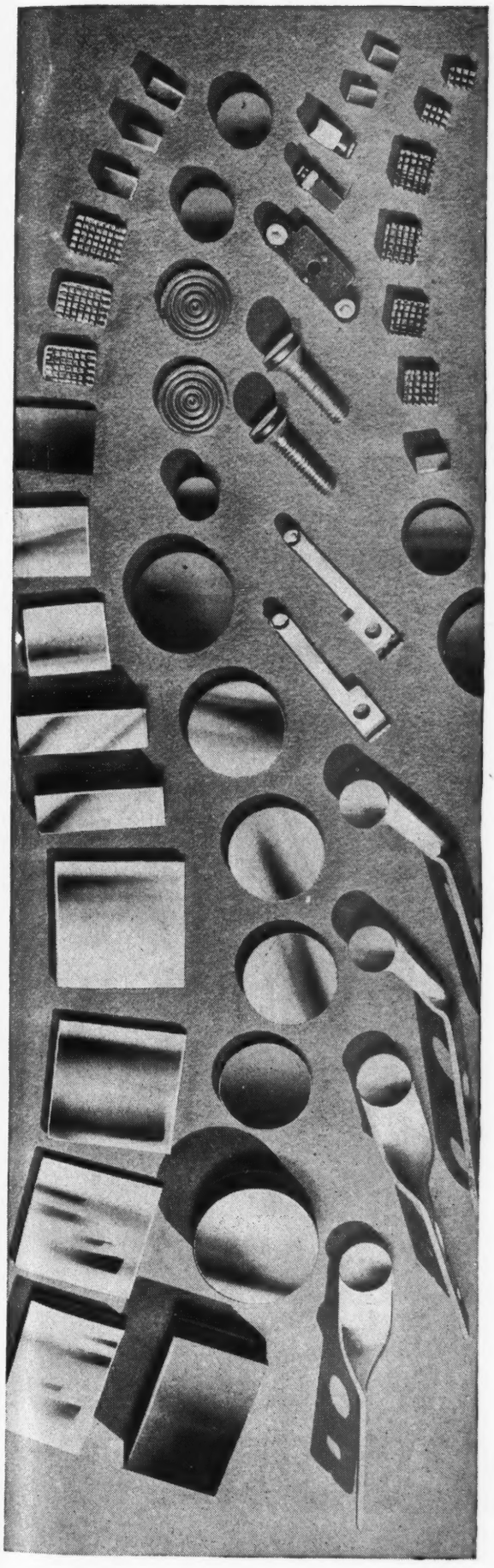
Your employees will require little "selling" on the idea—they are accustomed to their monthly saving habit. With the Treasury Department's savings bond program now in peacetime operation, your partnership is again invited to continue this systematic, convenient means of contribution to a prosperous peacetime future.

The Treasury Department acknowledges with appreciation the publication of this message by

AVIATION

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and Advertising Council

ANOTHER WILCO DEVELOPMENT



Wilcoloy

(SINTERED POWDER METAL CONTACTS)

WILCOLOY *offers* Longer Contact Life . . . Greater Resistance to Interrupting Loads, *and many other advantages for high current applications.*

PROPERTIES AND CHARACTERISTICS—WILCOLOY Silver Tungsten, Copper Tungsten, Silver Graphite, Silver Molybdenum and other WILCOLOY contact materials assure a degree of longevity, and thermal and electrical properties not possible to materials previously used in applications subject to severe current interruptions.

These Sintered Powder Metal Contacts offer a choice of properties including ductility, hardness, density, freedom from sticking, low metal transfer, high conductivity and arc-resistance. They perform uniformly and dependably in heavy duty circuit breakers, both air and oil relays, aircraft units, motor brushes, commutator segments, fuse replacement units and other specialized applications.

CONSULT OUR ENGINEERING DEPARTMENT—Write our Engineering Department for help in developing the proper application of WILCO materials to your products.

SEND FOR WILCO BLUE BOOK—The Blue Book contains descriptions of most WILCOLOY Sintered Powder Metal Contacts and other WILCO products. Send for FREE copy today.

WILCO PRODUCTS INCLUDE:

CONTACTS—
Silver
Platinum
Tungsten
Alloys
Sintered Powder Metal

THERMOSTATIC BIMETAL—
All Temperature ranges, deflection rates and electrical resistivities.

PRECIOUS METAL COLLECTOR RINGS—
For rotating controls

SILVER CLAD STEEL—

JACKETED WIRE—
Silver on Steel, Copper, Invar or other combinations requested.

ROLLED GOLD PLATE

SPECIAL MATERIALS

THE H. A. WILSON COMPANY
105 Chestnut Street, Newark 5, N. J.
Branch Offices: Chicago • Detroit • Los Angeles

SPECIALISTS FOR 30 YEARS IN THE MANUFACTURE OF THERMOMETALS ELECTRICAL CONTACTS • PRECIOUS METAL BIMETALLIC PRODUCTS

SINCLAIR KEEPS PACE...

Scale model of Sinclair Oil Corporation's new petroleum research and development laboratories planned for Harvey, Illinois. Studying the model (l. to r.) E. W. Isom V. P. Chg. of Research and Development, Sinclair Refining Company; Howard Jehu, Harvey Association of Commerce; Arthur E. Turngren, Mayor, and Sheldon Clark, Chairman, Executive Committee, Sinclair Oil Corporation.

with MODERN AVIATION PROGRESS

INCREASED facilities for research into all uses of petroleum and its products will be provided in Sinclair Oil Corporation's elaborate new research laboratory planned for Harvey, Illinois.

In this most modern of laboratories, recognized experts in petroleum technology will further the development of new and improved aviation fuels and lubricants to keep pace with the rapid expansion of present-day flying.

For over 15 years, Sinclair has pioneered in the development and manufacture of high quality aircraft engine oils and other aircraft lubricants. With the opening of the new research center, Sinclair will be in an even better position to cooperate in and promote the advancement of aviation in all its fields.

SINCLAIR AVIATION OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

this flexible metal hose resists . . .

HIGH TEMPERATURE
REPEATED FLEXING
HIGH PRESSURE
CORROSION
VIBRATION

The flexibility of rubber . . . **plus the all-'round stamina of Monel, Nickel and Inconel** . . . is yours when you use flexible metal hose made by Eclipse.

The hose carries steam, corrosive fluids and gases. In some of the smaller diameters, test pressures up to 3000 p.s.i. have been applied with safety. And, with Inconel flexible hose now being successfully produced experimentally, the temperature ceiling has been raised to 2000° F.

The tubing is absolutely leakproof, for it is really a seamless metal tube that has been compressed into a series of bellows-like corrugations.

With corrugations deep, parallel, and rounded at top and bottom, the tubing is highly flexible.

Diameters as small as ⅛" are available.

If you've been bothered by rubber or soft metal tubing that can't "take" it, investigate all-Monel, all-Nickel or all-Inconel flexible tubing. For more information, write the manufacturer: Metal Hose Dept., Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N.Y.

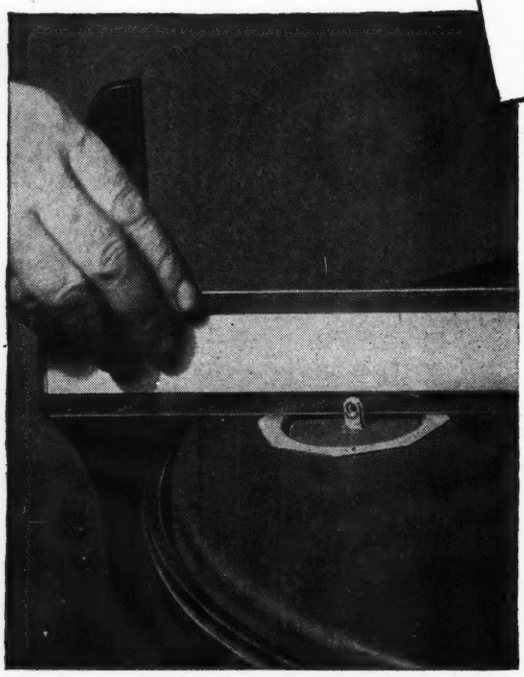
NICKEL INCO TRADE MARK **ALLOYS**

MONEL* • "K" MONEL* • "R" MONEL* • "KR" MONEL* • "S" MONEL* • INCONEL* • NICKEL • "L" NICKEL* • "Z" NICKEL*

*Reg. U.S. Pat. Off.

Dividend— 650 GALLONS

— returned through
TRI-SURE FULL DRAINAGE
in average
10,000-drum shipment



The T Square Test shows the flush fitting of the Tri-Sure Flange which guarantees full drainage.

THE result of recent tests of closures by an independent oil company showed that Tri-Sure Closure fitted drums drained an average of 8.34 ounces more than the others. Figured on the scale of a 10,000—55-gallon drum shipment, the consumer will recover 650 gallons or over which otherwise would have remained in the drums.

The flush fitting of Tri-Sure flanges assures complete drainage and you receive all you pay for.

Mark your orders, "Drums to be fitted with Tri-Sure Closures."

Tri-Sure
Reg. U. S. Pat. Off.
CLOSURES

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

earthbound or skyborne

they have this in common

To solve the complex problems arising in the operation of such mighty airliners as the Lockheed Constellation, Foote Bros. have developed Power Units, light in weight, compact in size, that apply power exactly where it is needed at the force required, whether it be measured in ounces or tons.

In small personal planes, these units will relieve the pilot of many manual operations and in jet propulsion engines they have proved of great value in operating accessory drives.

Because Foote Bros. Power Units permit great flexibility in the transmission and control of power, many other applications have been developed other than aircraft. On road construction machinery, printing presses, radar antenna drives and literally hundreds of other types of equipment—these compact, efficient units can aid in assuring more instantaneous response—in providing quieter, better operation. They make performance more nearly automatic and assure more precise control.

Foote Bros. engineers will work with you on the design of a Power Unit to meet your specific need.

A recently issued bulletin on Power Units giving complete engineering data on "packages of power" will be sent on request. Also available is a bulletin on Aircraft Quality Gears. Mail the coupon.

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION

Dept. G, 5225 South Western Boulevard, Chicago 9, Illinois

Foote Bros. Gear and Machine Corporation Dept. G
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Gentlemen: Please send me Bulletins checked below.
☐ Power Unit Bulletin ☐ Aircraft Quality Gear Bulletin

Name.....

Position.....

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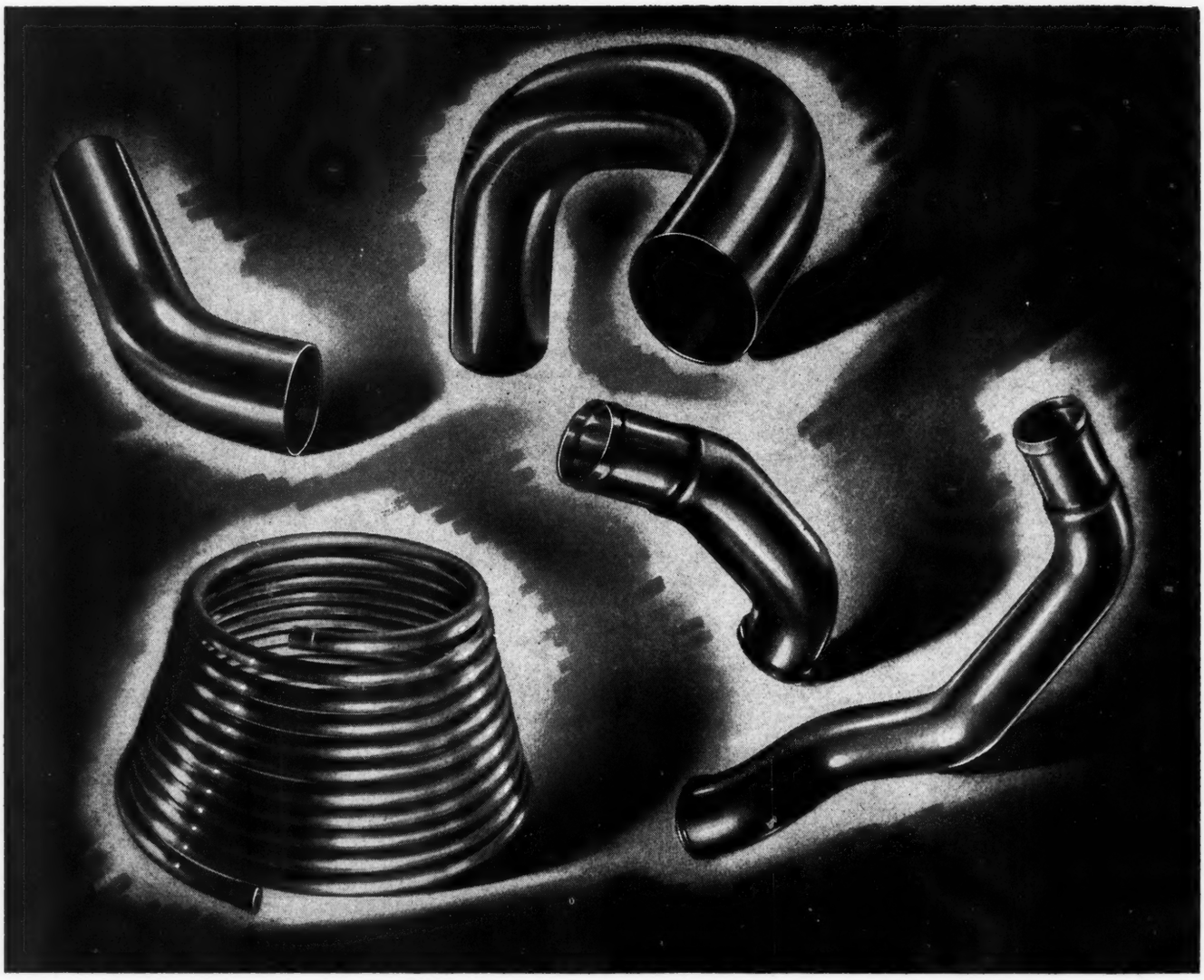
Address.....

City.....*State*.....



Not All Tubing can be Bent to All Shapes

The coil and parts above illustrate a few of the many possibilities of shaping and bending seamless steel tubing. In such applications—where very severe bends are required—seamless steel tubing is usually the most suitable type for the job, because of its formability and superior working qualities.

Of course, properties required in tubing used for bending vary with the type of bend and manner of fabrication. However, two prime requisites are universal—high quality and consistent characteristics.

In addition to modern plant facilities obviously needed for meeting such rigid specifications, Michigan Seamless insists upon strict manufacturing controls over those properties required for good forming such as grain structure, chemical analysis, surface finish, ductility, and other mechanical properties.

Only such exacting measures can produce tubing suitable for bending into intricate forms. Our engineering and laboratory facilities are available without obligation for research and development for your individual requirement.

MICHIGAN TUBING

MICHIGAN SEAMLESS TUBE COMPANY

SOUTH LYON ★ MICHIGAN

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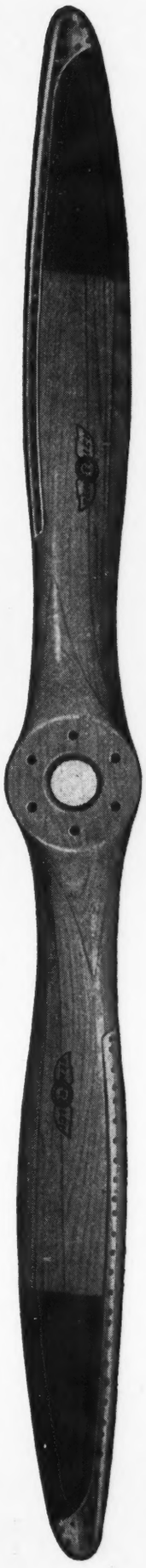

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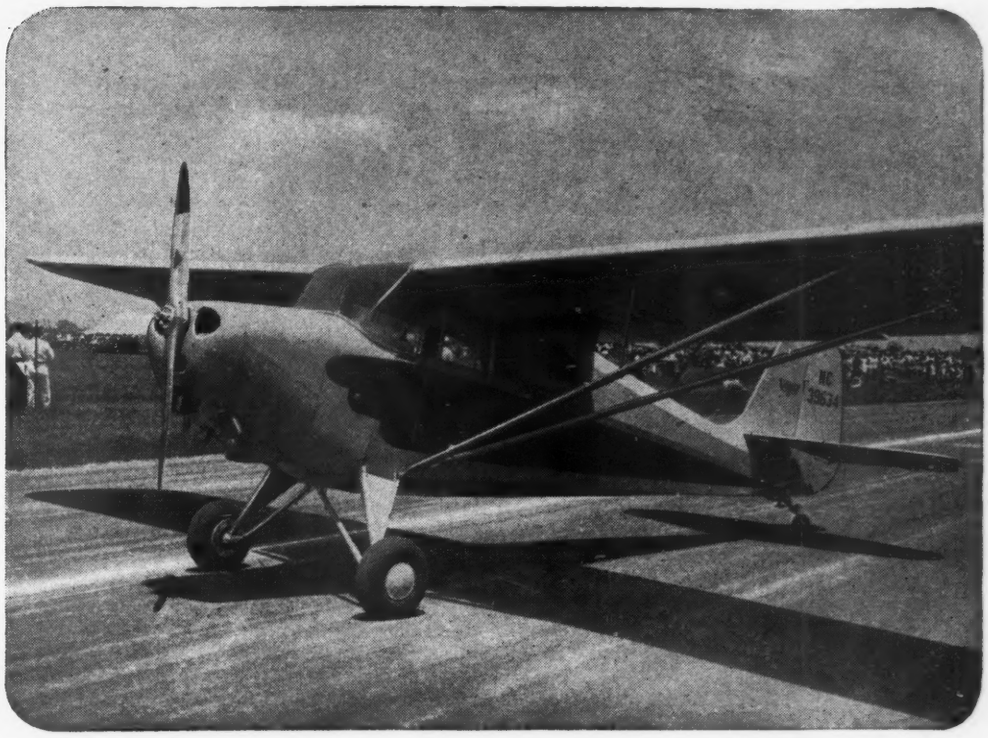

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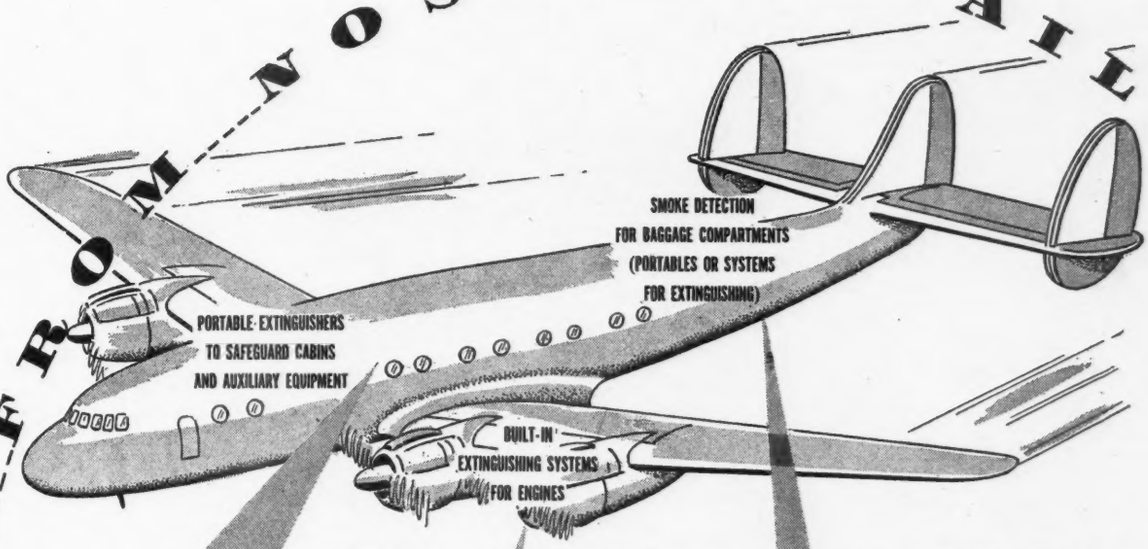

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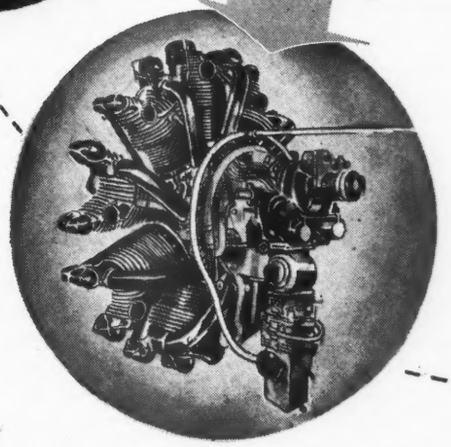

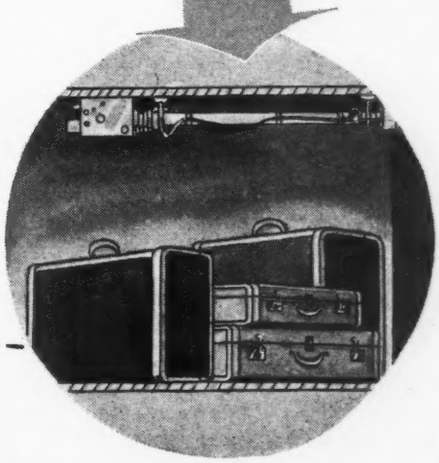

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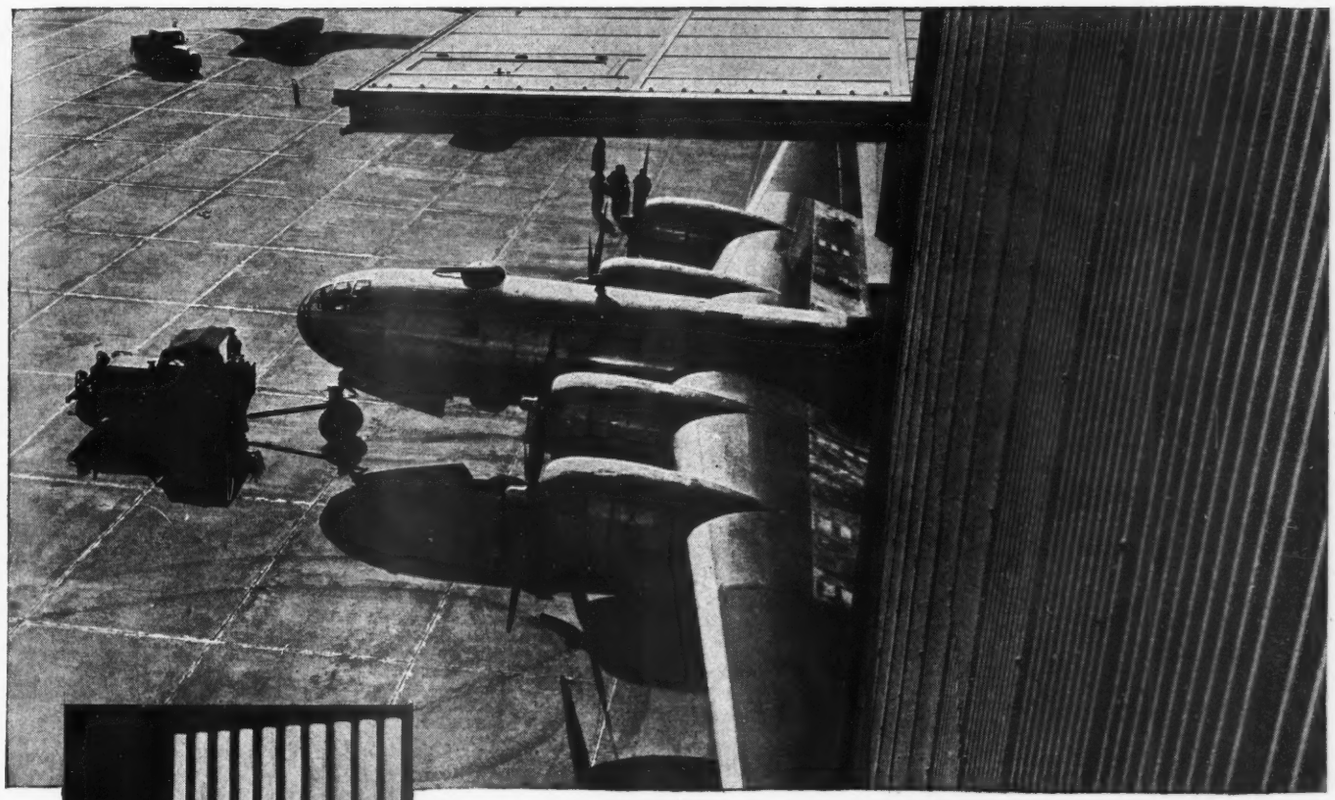

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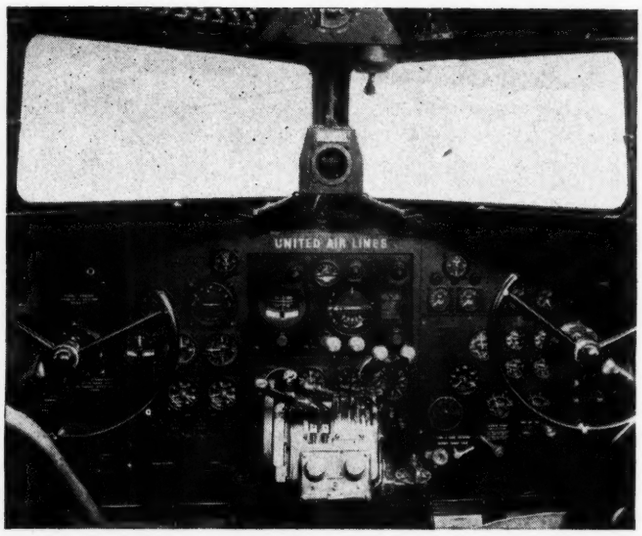

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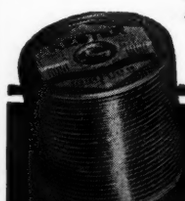

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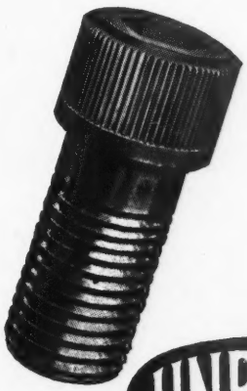

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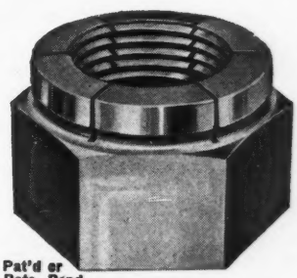

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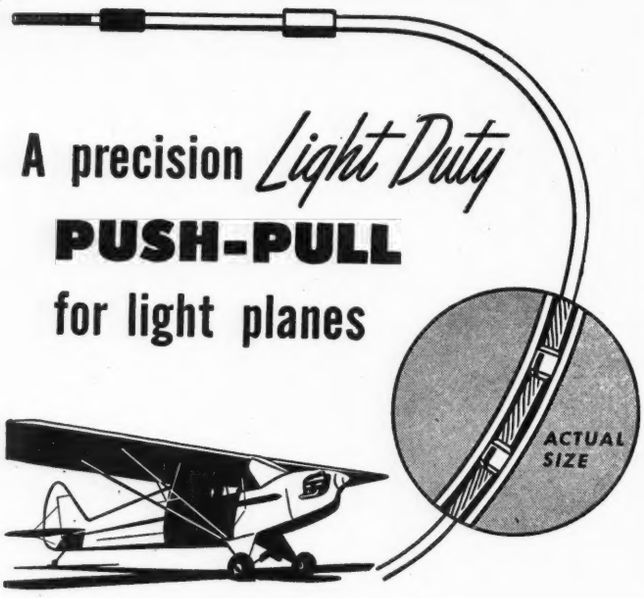

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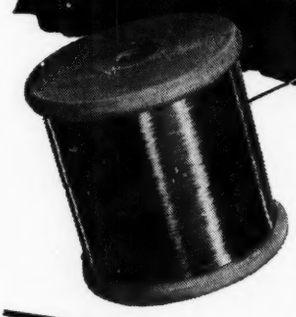

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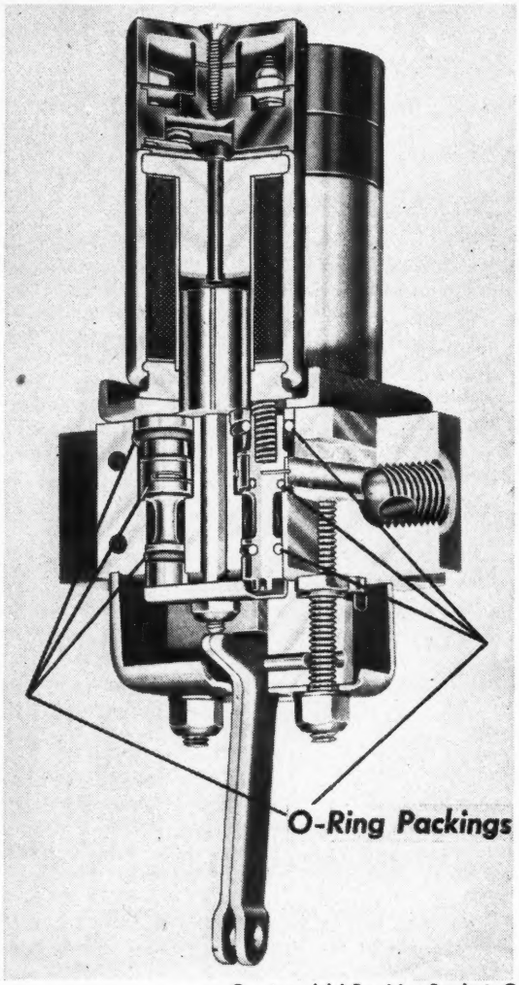

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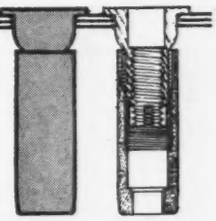
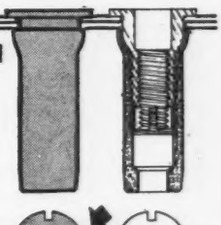
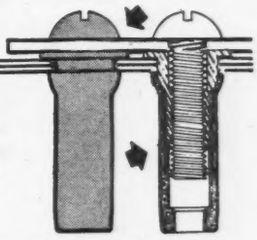


3 Draw LOK-SKRU sleeve against inner side of metal with special power or hand tool, to rivet sheets securely. LOK-SKRU head, tapped for 6, 8, or 10/32 machine screw, provides an anchor nut.



4 Screw, to fasten attachments, is locked in anchor nut by tension grip.



Disassembled LOK-SKRU with screw for attachments

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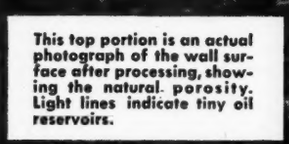

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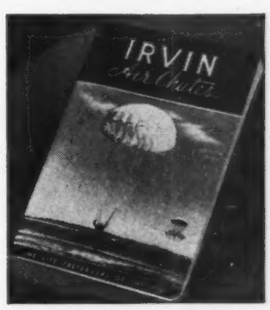

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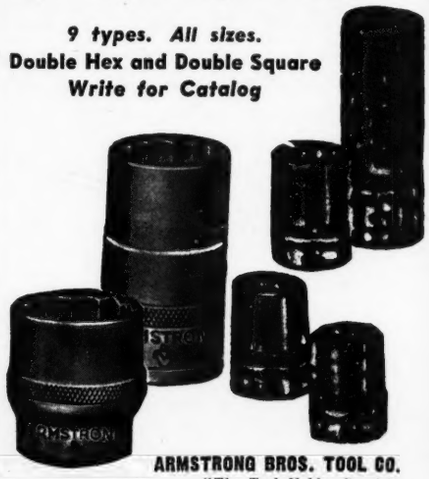

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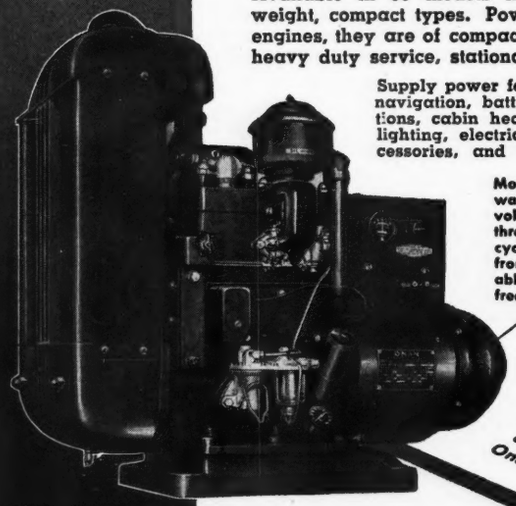

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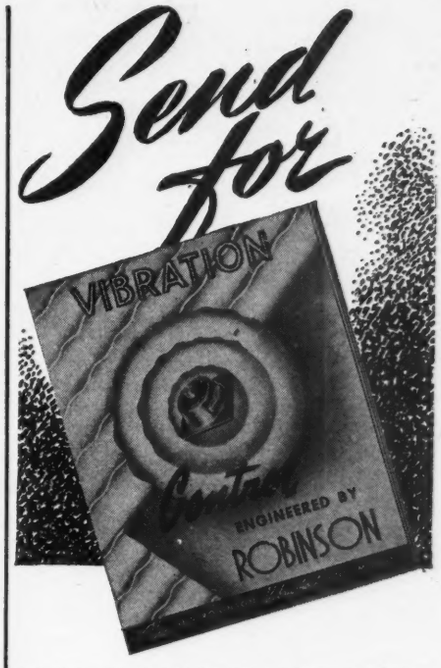

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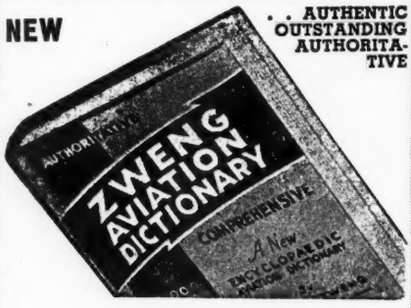

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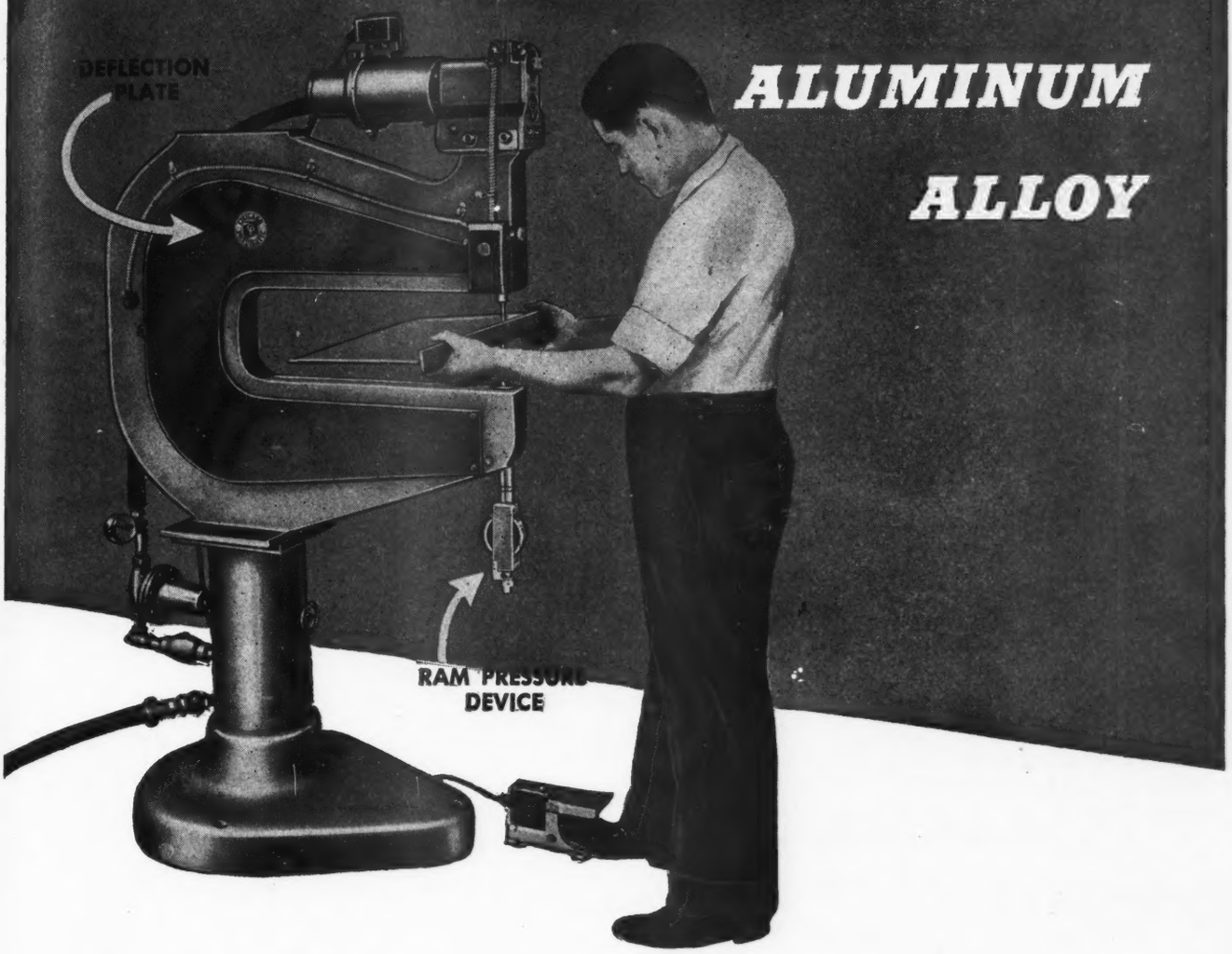

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Independent Investigator Finds

BENDIX HOME APPLIANCES, INC.

3 enlists advantages of Phillips Screws to make BIG ASSEMBLY SAVINGS

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"THEY'RE MUCH, MUCH FASTER by every driving test," Harry L. Spencer, Bendix V. P. in charge of manufacturing, told the investigator. "Since we'll use well over 19,000,000 Phillips Screws this year on washer production alone, that means an important saving.

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"UNSIGHTLY SLOTS with burrs to snag clothes just couldn't be tolerated on a washer. We get no burrs with the Phillips Head – and it looks well, wherever it shows."

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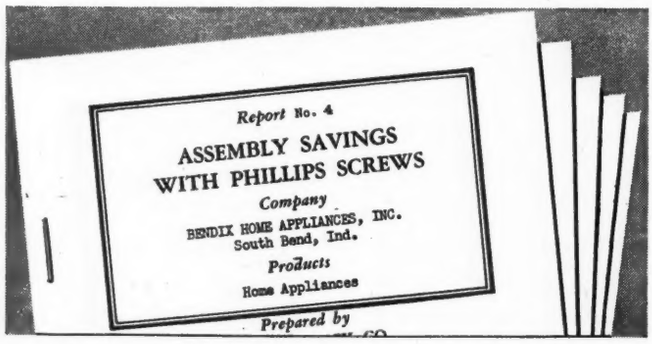

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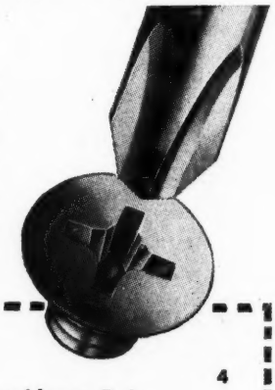

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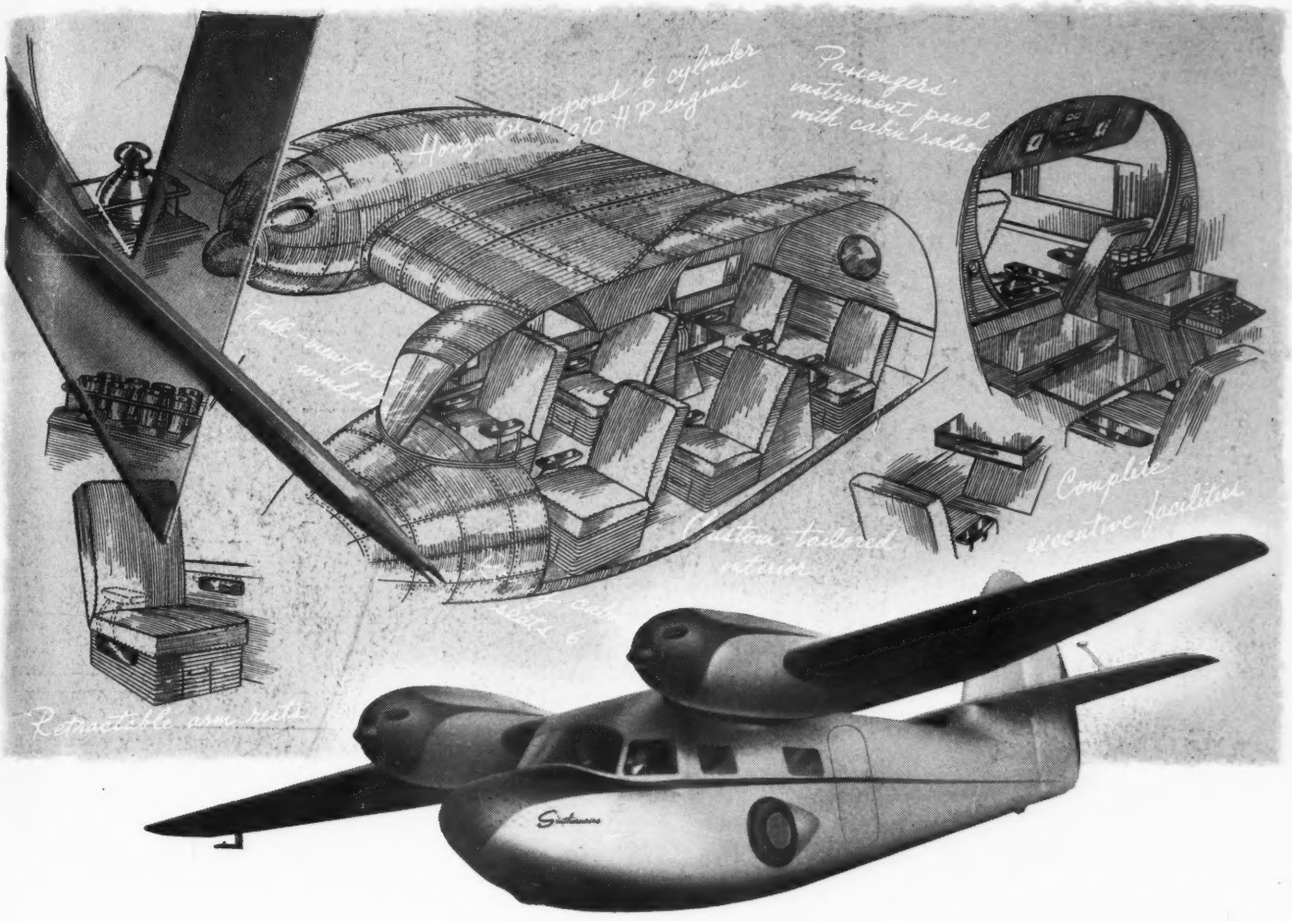

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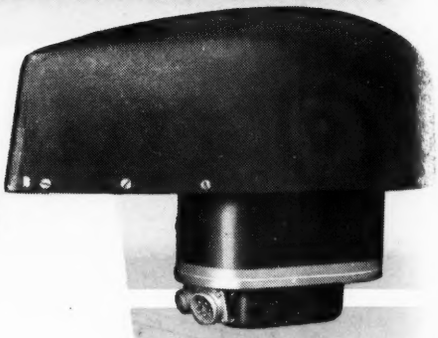

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A new example of Bendix Radio Creative Engineering—The NA-1 System furnishes automatic visual bearings and simultaneous aural reception of cw, mcw or voice signals in the range 100-1750 kc. It also serves as a low frequency range receiver, or manual direction finder, and operates on a straight wire antenna or static reducing loop throughout its frequency range.

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MN-63A

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